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ABSTRACT

As a replacement of the 1949 primary training manual for supplementary aeronautical weather reports, instructions are presented in this Training Paper No. 5 for the purpose of guiding learners through their study of the Weather Service Observing Handbook (WSOH) No. 4. The content is divided into six chapters concerned with such topics as introduction to aviation weather observation, sky conditions, ceiling heights, sky cover, obscuring phenomena, visibility, atmospheric phenomena, temperatures and dewpoint, and wind. Each chapter includes a reading assignment corresponding to the WSOH No. 4 content, a detailed discussion section, and a set of review questions with answers. Emphases are placed on the use of trained encoding skills to take and record surface SAWRS observations. Included are a meteorological form 1-10C, illustrations for explanation purposes, ceiling designators for layers aloft, a sample visibility chart, and summaries of sky condition, visibility, temperature data, weather, and obstruction-to-vision entries. (CC)

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Training Paper No. 5

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Weather Service

ED 082946

Training Guide in SURFACE SAWRS OBSERVATIONS

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April 1972

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RECORD OF CHANGES

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Training Paper No. 5

Training Guide in SURFACE SAWRS OBSERVATIONS

Supersedes "Primary Training Manual for Supplementary Aeronautical Weather Reports," April 1949

Data Acquisition Division

SILVER SPRING, MARYLAND
APRIL 1972

CHANGES TO TRAINING GUIDE. Corrections, revisions, and additions to this publication will be made only as issued or directed by published changes. Such changes will be issued by the National Weather Service Headquarters only. Record the entry of these changes into the Training Guide in the spaces provided on the inside of the cover.

Suggestions for changes to this Training Guide are welcome. Submit suggestions to the National Weather Service Regional Headquarters, or to your Supervising Station.

PREFACE

The purpose of Training Paper No. 5 is to guide you through your study of Weather Service Observing Handbook No. 4, SAWRS Surface Observations (WSOH No. 4). The instructions in the Training Paper are not intended to be all inclusive. Therefore, it is necessary to use the Training Paper in conjunction with WSOH No. 4.

Each chapter of this Training Paper is divided into three sections. These sections are (1) Reading Assignment, (2) Discussion, and (3) Review Questions.

The reading assignments list those chapters, pages, or paragraphs in WSOH No. 4 that you should read before going on to the discussion. Certain instructions are of particular importance and you will be advised in the reading assignment to either study, or in some cases, memorize them.

After you have completed the reading assignment, return to the training paper and read the discussion. The discussion explains and clarifies parts of WSOH No. 4 that have proven troublesome for new observers in the past. Occasionally the discussion will explain why a certain element is required to be reported. This is done in the belief that if you know why, remembering how and when will not be so hard.

Once you are confident that you are familiar with the contents of both the reading assignment and discussion, proceed to section 3, the review questions. Answer each of the questions but DO NOT guess at the answers. If in doubt, look up the answer in WSOH No. 4, not in the Training Paper. In this manner, you will become familiar with the organization of the Handbook as well as the instructions.

Correct answers to the review questions are given at the end of each chapter. Use these answers only after you have answered all questions in the chapter. If you have made a mistake locate the appropriate instruction in WSOH No. 4 and determine where you went wrong.

CHAPTER 1

GENERAL

The purpose of this chapter is to introduce you to the Aviation Weather Observation, and to some of the procedures used in the observing program. Following chapters will dwell on observing the individual elements of the observation.

READING ASSIGNMENT

Preface
Chapter A1 - Read all; study ¶6., 7., and 8.
Chapter A2 - Read all; study ¶1.4, 2.2, and table A2-1.
Chapter A3 - Read ¶1.1 thru 2.2, 2.13 thru 2.13.1.1, 2.13.8, 2.15, and 2.90; study ¶1.2 and 1.3.1.2.
Chapter A4 - Read all; study ¶4.2.

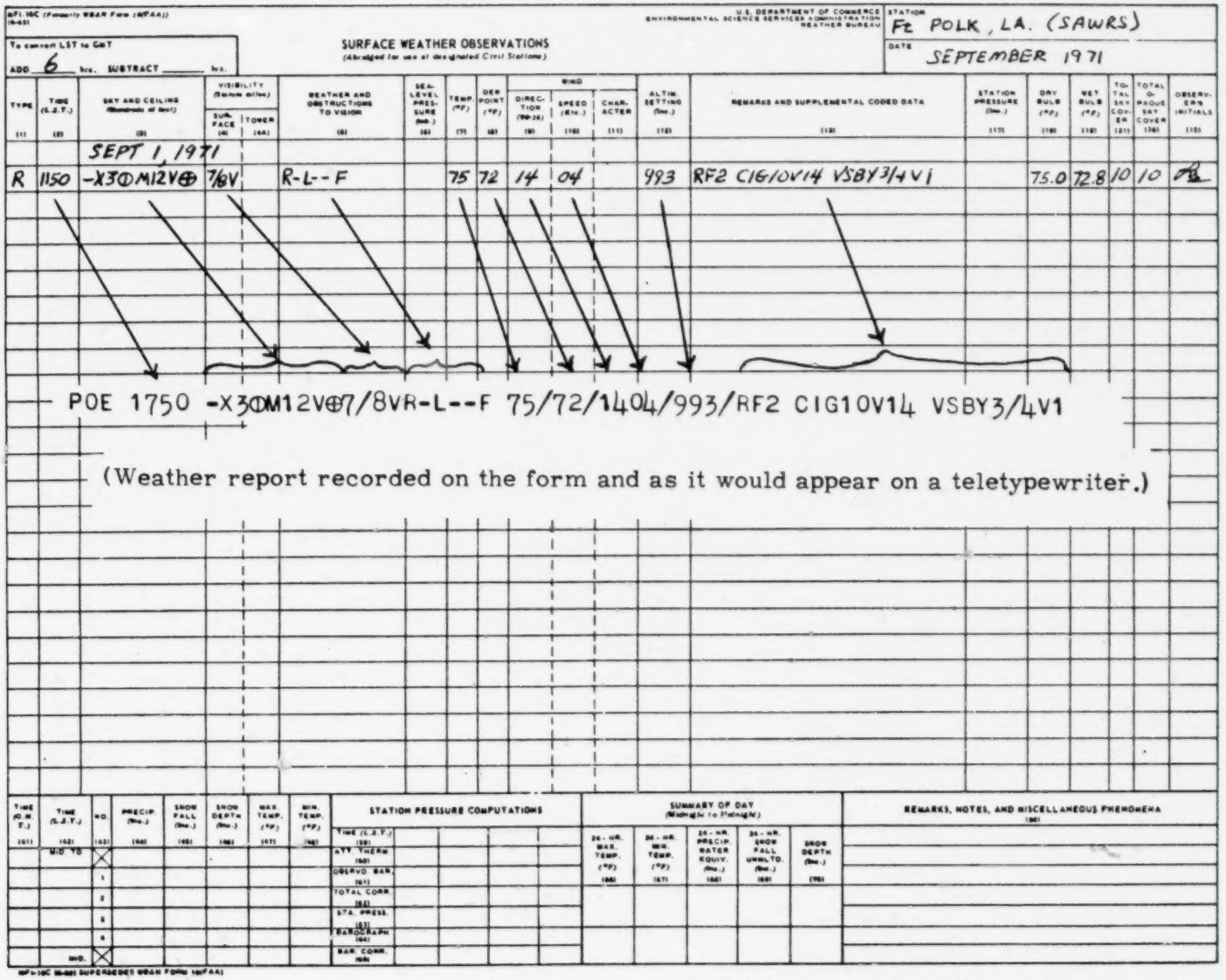
DISCUSSION

Before getting into the study of Aviation Weather Observations, it might be helpful to know just what an observation is. Technically, an observation is the act of evaluating the various meteorological elements that together describe the atmosphere as viewed from the observer's position. But, in everyday use, the observation is understood to include not only the evaluation of the elements, but also the weather report, i.e., the encoded message used to describe what was observed.

The meteorological elements SAWRS normally observe are: Ceiling and Sky Condition, Visibility, Weather and Obstructions to Vision, Temperature, Wind, and Altimeter Setting. SAWRS also include Remarks which are pertinent to these elements, and if required, Dewpoint is also observed.

Although it may seem so at first, observing the elements is not difficult. It is only a matter of learning what to look for and what to see. This part of your job requires a skill that you will acquire as you gain experience. Making up the message, or report, (see fig. 1-1) is a little more difficult.

Several things should be kept in mind as you make up the weather report. First and most important is to make it as accurate as possible. Second, make the report as descriptive and representative of actual conditions as the code allows. To accomplish these objectives, you will find that at first you will spend nearly as much time (and sometimes more) making up the report as you do observing the elements. However, as you gain experience, you will find yourself thinking in terms of the Aviation Weather Code, and from then on, encoding the report will not take as long.



SURFACE WEATHER OBSERVATIONS

STATION: Ft POLK, LA. (SAWRS)

DATE: SEPTEMBER 1971

To convert LST to GMT: ADD 6 hrs. SUBTRACT _____ hrs.

TYPE	TIME (L.S.T.)	SKY AND CEILING	VISIBILITY (Statute miles) SURFACE	VISIBILITY (Statute miles) TOWER	WEATHER AND OBSTRUCTIONS TO VISION	SEA-LEVEL PRESSURE (mb.)	TEMP. (°F)	DEW POINT (°F)	WIND DIRECTION (tens of degrees)	WIND SPEED (Knots)	WIND CHARACTER	ALTIM. SETTING (Ins.)	REMARKS AND SUPPLEMENTAL CODED DATA	STATION PRESSURE (Ins.)	DRY BULB (°F)	WET BULB (°F)	TOTAL SKY COVER	TOTAL OPAQUE SKY COVER	OBSERV. ER'S INITIALS
		SEPT 1, 1971																	
R	1150	-X3⊙M12V⊕	7/8V		R-L--F		75	72	14	04		993	RF2 CIG10V14 VSBY3/4V1		75.0	72.8	10	10	

POE 1750 -X3⊙M12V⊕7/8VR-L--F 75/72/1404/993/RF2 CIG10V14 VSBY3/4V1

(Weather report recorded on the form and as it would appear on a teletypewriter.)

TIME (G.M.T.)	TIME (L.S.T.)	NO.	PRECIP. (Ins.)	SNOW FALL (Ins.)	SNOW DEPTH (Ins.)	MAX. TEMP. (°F)	MIN. TEMP. (°F)
	MID. YR.	X					
		1					
		2					
		3					
		4					
	MID.	X					

STATION PRESSURE COMPUTATIONS

TIME (L.S.T.)	
ALT. THERM.	
OBSERVD. BAR.	
TOTAL CORR.	
STA. PRESS.	
BAROGRAPH	
BAR. CORR.	

SUMMARY OF DAY (Midnight to Midnight)

24-HR. MAX. TEMP. (°F)	24-HR. MIN. TEMP. (°F)	24-HR. PRECIP. WATER EQUIV. (Ins.)	24-HR. SNOW FALL UNMELTD. (Ins.)	SNOW DEPTH (Ins.)

REMARKS, NOTES, AND MISCELLANEOUS PHENOMENA

MF1-10C (6-65) SUPERSEDES WBAN FORM 10(FAA)

Figure 1-1. Meteorological Form 1-10C (MF1-10C). Form shows a sample observation entered and the insert shows how the sample observation would look when transmitted on a teletypewriter.

Weather Service Observing Handbook No. 4, SAWRS Surface Observations, defines this code as it applies to SAWRS, and gives the procedures used to observe the elements in the code.

WSOH No. 4 is a much abridged version of Federal Meteorological Handbook No. 1, Surface Observations, a much larger publication used at National Weather Service (NWS) stations. WSOH No. 4 contains only those instructions used by the majority of SAWRS. Otherwise, the organization of both Handbooks is the same. In general, the most important points of this organization are:

1. Paragraph numbers are such that the first digit represents the section number, and the decimals following the section number indicate paragraphs and subparagraphs. References such as (see ¶2.2.3) indicate a paragraph in the same chapter while a reference such as (see ¶A5-3.2.1) indicates paragraph 3.2.1 in chapter A5.

2. Section 2 of each chapter (except chapter 3) contains definitions. If you want to know what something is, this is where you should look first.

3. Section 3 of each chapter gives details on observing the various elements.

4. Chapter 3 explains how to make entries on Meteorological Form 1-10 (MF1-10). This is probably the most heavily used chapter in the Handbook, and it contains most of the information needed to take and record an observation, without getting into details. Note that beginning with paragraph 2 in this chapter, the numbered subparagraphs refer to the respective column numbers on MF1-10. For example, paragraph 2.10 refers to column 10, Wind Speed.

5. Chapter 12 tells how to operate various types of equipment.

6. Chapter B2 contains maintenance instructions for equipment.

While WSOH No. 4 is quite complete, it is impossible to give details on reporting everything that might happen at, or in view of, a weather station. Therefore, we stress that you include in your report any weather phenomena you consider significant to aircraft operations or to safety of life and property. If it is not occurring at your station, put it in Remarks. If you do not know the authorized contractions, spell it out.

The standard form used to log observations is MF1-10C (see fig. 1-1). This form not only serves as a record of observations but also serves as a valuable aid for encoding the weather report. Once entries are made on the form, the observation is ready to go. It is disseminated just as it is entered on the form.

When using this form, remember that all time entries in column 13 (Remarks) are in Greenwich Mean Time (GMT), and that all other times on the form are in Local Standard Time (LST). Daylight Saving Time is never used on the form or in the observation.

If you make a mistake on the form, and discover the error BEFORE THE OBSERVATION IS GIVEN TO ANYONE, correct the error using the same writing implement used to record the observation. However, if an error is discovered AFTER THE OBSERVATION WAS GIVEN TO SOMEONE, you must make the correction using a red pen or pencil. In either case, cancel the erroneous data by clearly drawing a line through it; e.g., ~~88~~. Do not obliterate the entry by writing over it or covering it up; e.g., ~~88~~.

If you give the correction to any of the recipients of the erroneous data, (and you should if the observation is still significant) make note of this in column 13 in parentheses. If the correction is given to all recipients of the erroneous data, just enter COR followed by the time the correction was given out. If the correction was given only partial distribution, indicate what was done; e.g., (COR to PAA and TWR at 1337).

At the end of each month, send the originals of all MF1-10's used during the month to the station designated by the NWS Regional Headquarters. This station will check the forms and advise you of any errors they find. If no errors are found, they will advise you of that also.

When you receive this notification, review the errors and try to determine why they were made. This is one of the reasons you make the carbon copy of the MF1-10. If the "Error Letters," as they are usually referred to, are used in this manner, they can be a valuable tool to help you do a better job of observing. After you have reviewed the Error Letters, keep them on file on the station until a representative from the NWS visits your station and reviews your records.

Once you have reviewed the error letter, you can discard the associated copies of the weather records if they are 30 days old, or older. However, it is not mandatory that you discard these records after 30 days, and you are encouraged to retain them on station until they are reviewed by the NWS representative.

In the reading assignment, you were introduced to three different types of observations: Record, Special, and Local.

Record Observations are those taken at some prescheduled time, and on a regular basis. When establishing the observation schedule for your station, the NWS representative will explain which of your observations (if any) should be designated as Record Observations.

Special Observations are taken normally to report certain significant changes in weather conditions. There are three categories of criteria for taking Specials. The first is applicable to all stations across the Nation. These criteria are given in chapter 2 of WSOH No. 4. The second category is that of local operating minimums. To determine these, it will be necessary to examine the approach plates for your field, and extract all published minima applicable to the field. The third category of criteria for taking Specials is up to you. This criterion requires you to take a Special Observation to report any phenomenon that in your opinion is critical to aircraft operations at your field. In making these Special Observations there are no limits. Even if no provision is made for reporting a particular occurrence, take a Special and report the phenomenon, even though it is necessary to use plain language.

Local Observations serve two purposes. If there is an Aircraft Mishap near the field, the Local Observation serves to document the weather conditions as near to that time as possible. Locals can also be used to record the occurrence of some other phenomenon, which is not considered significant enough to justify a Special. The main difference between a Special and Local is that no dissemination is required of a Local whereas the Special must be disseminated.

Because of the great variety of observational programs at SAWRS, it is impractical to explain in this paper how the various observations apply to each station. Therefore, you should discuss this part of the program with either the Surface Observations Specialist from the NWS Regional Headquarters, or the representative from the Supervising Station when they visit your station.

REVIEW QUESTIONS

1. What are the designators used in column 1 of MF1-10C for the following types of observations?

   a. Special

   b. Local

   c. Record

   d. Record Special

2. Weather conditions being equal, why should you allow more time for taking observations at night than during the day?

3. If you decide at the time of an observation that the normal procedures given in WSOH No. 4 are inappropriate for the circumstances at hand, what should you do?

4. How often should time checks be made on the clock used as the station standard?

5. How long should you retain carbon copies of MF1-10?

6. When the actual cloud height or visibility falls midway between two reportable values, which value should be used?

7. The time entered in column 2 of MF1-10 is the _____Time of the observation.

8. Insofar as possible, what is the maximum amount of time allowed for observing all the elements of the observation?

9. Under what conditions may you omit taking a Local Observation when notified of an Aircraft Accident?

10. If you discover an error in column 5 after you have given the observation to a pilot over the radio, you should correct the error by:

    a. Erasing the erroneous entry and entering the correct data in red,

    b. Erasing the erroneous entry and entering the correct data in black,

    c. Drawing a line through the erroneous entry and entering the correct data in red, or

    d. Drawing a line through the erroneous entry and entering the correct data in black.

11. All time entries in column 2 of MF1-10 are made in reference to _____time with reference to the_____ hour clock.

12. A_____Observation should be made upon notification of an Aircraft Mishap, and the Remark _____should be entered in column 13.

ANSWERS TO REVIEW QUESTIONS

1. a. S

   b. L

   c. R

   d. RS (A3-2.1)

2. You must allow time for your eyes to become adjusted to the darkness. (A2-3.5)

3. You should follow the instructions as given in the Handbook. If the instructions are inappropriate because they are incomplete or do not cover the situation observed, follow the instructions given as closely as possible but exercise your judgment as to what should be reported. WSOH No. 4 gives minimum requirements. You may report anything you observe in addition to the stated requirements. (A1-6)

4. Daily at part-time stations, or on every shift at full-time stations. It would be wise to make a time check if there is an unusual severe storm that damages aircraft, or if there is an Aircraft Mishap. (A2-1.3)

5. Thirty days is the minimum. However, you are encouraged to keep them until visited by an Observations Specialist from the Regional Headquarters. If these forms are available to him, he will be better able to help you improve your observation program. (A2-1.8)

6. Use the lower value. This is done in the interest of safety. (A2-1.4c)

7. Actual. (A3-2.2 and A2-2.2)

8. Fifteen minutes. (A2-3.4)

9. Only if a Record or Record Special Observation was taken between the occurrence of the Aircraft Mishap and the time you were notified. If this should happen, it would be to your advantage to enter the time of notification either in Remarks in parentheses, or in block 90, e.g., (Notified of ACFT MISHAP at 1703). (A2-3.7.3)

10. c. (A3-1.3.1.2)

11. Local Standard; 24-hour. (A3-2.2 and A2-3.1)

12. Local; (ACFT MISHAP) (A2-3.7.3)

CHAPTER 2

SKY CONDITION

Sky Condition is the first element in an Aviation Weather Report. It describes the appearance of the Celestial Dome (see fig. 2-1) from the point of observation. As an observer, strive to make these data as descriptive of present conditions as the code allows. Although many sources of information are available to you, such as pilot reports, balloons, and ceiling lights, the data reported must be that which you consider representative of conditions at your location and, in most cases, visible to you. You must realize that you have the authority and the responsibility of determining what is and what is not representative at your station. When you put your initials in column 15 of MF1-10C, you certify that the observation is yours.

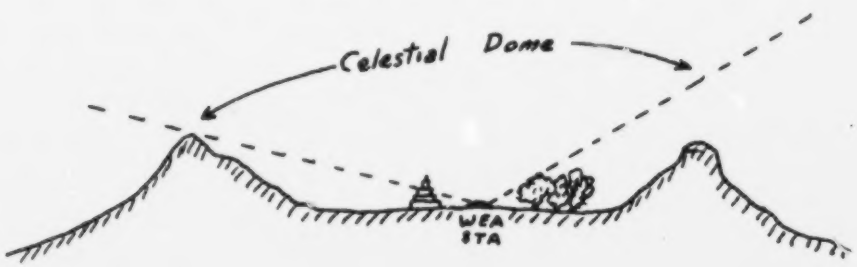


Figure 2-1. The Celestial Dome is that portion of the sky that would be visible above the natural horizon if you had an unobstructed view of the natural horizon. Note that in the illustration the boundaries of the Celestial Dome are effected by the mountains on the left and the trees on the right (both natural objects) but are not effected by the building on the left.

PART I - SKY COVER

READING ASSIGNMENT

Chapter A5 - Read ¶2.1.1, 2.6, 2.7, 2.8, 2.11, 2.12, 2.17, 2.19, and 3.1 thru 3.4.2.
Chapter A3 - Study ¶2.3 and 2.3.1.

DISCUSSION

Since Sky Cover is reported for each layer of clouds or obscuring phenomena visible from the station, it is necessary for you to learn what constitutes a layer and what constitutes Sky Cover. One thing to remember is that clouds at approximately the same level constitute a layer. This is discussed in the last part of this chapter. A second point to remember is that certain types of clouds tend to spread out at higher levels so you must use your judgment to decide whether to call them separate layers or one layer. The determining factors are whether the clouds caused by the spreading out are horizontal, and whether they are at a level different from the parent cloud. In figure 2-2, cloud A would be reported as two layers, one at 2,500 feet, the other at 20,000 feet, cloud B would be reported as one layer at 2,500 feet.

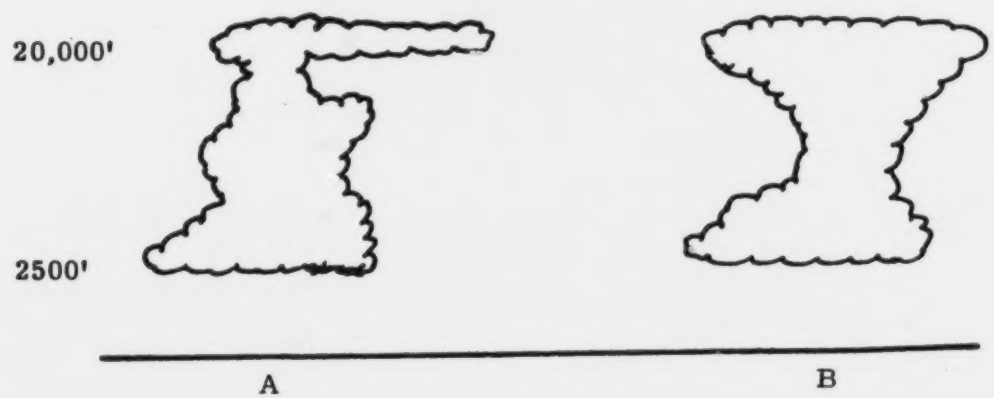


Figure 2-2. Single cloud vs. multiple layers.

Until you have become more experienced in observing clouds, you may have some difficulty in determing when multiple layers are present. Several guides can be used for this purpose:

1. If a ceiling light is available, observe whether or not spots are visible at several different levels. Several well defined spots separated by relatively clear spaces indicate multiple cloud layers.

2. If multiple layers are suspected, try to detect differences in direction of movement of various portions of the cloud layers. Although the absence of such differences in movement does not necessarily mean only one layer is present, (since the apparent cloud direction may be the same at several heights) this guide is usually reliable if the differences in height are great.

3. Differences in coloring and shading are helpful in distinguishing layers. In general, lower layers tend to be darker.

4. The types of clouds are also helpful in distinguishing multiple layers during daylight. Figures 2-13A, B, and C show the different types of clouds and their average heights.

Once you have broken the sky into separate layers, you are expected to determine the Sky Cover, in tenths, for each of the layers, and select a Sky Cover Symbol to represent each layer in the report.

If there is only one layer, determining the Sky Cover and Sky Cover Symbol is relatively easy. If the layer is on the ground, the Sky Cover is the tenths of sky that is <u>hidden</u> by the phenomenon. That portion of the surface-based layer through which the sky can be seen is ignored for the purpose of Sky Cover. The Sky Cover Symbols used to represent surface-based layers are -X and X only. If the Sky Cover for the layer is anything from 1/10 through 9/10 (to the nearest tenth), use the symbol -X. If the Sky Cover for the layer is 10/10, use the symbol X. For example, if a thick haze layer on the ground was completely covering the sky but was only hiding 6/10 of the sky from view, the Sky Cover for the layer would be 6/10, and the symbol used to represent the layer would be -X.

When the layer is aloft, that is, not on the ground, the Sky Cover of the layer is the amount of sky that is <u>covered</u> by the layer. For the purpose of determining Sky Cover of a layer aloft, it does not matter whether you can see through the layer or not. For example, if a layer aloft covered 8/10 of the sky, but the sky was visible through all portions of the layer, the Sky Cover for that layer would be 8/10. Select the Sky Cover Symbols for layers aloft as follows:

If the Sky Cover of the layer to the nearest tenth is:	The symbol used to represent the layer is:	Meaning
1/10 through 5/10	⌽	Scattered
6/10 through 9/10	◍	Broken
10/10	⊕	Overcast

If there are no layers, or if there is less than 1/10 of the sky covered by all layers, the Sky Cover Symbol O, meaning clear or less than 1/10 Sky Cover, is used. This symbol is never used in combination with other symbols; it is always used alone.

REVIEW QUESTIONS

1. The Sky Cover of a layer based at the surface is the amount of sky that is_____by the layer.

2. The Sky Cover of a layer aloft is the amount of sky that is_____ by the layer.

3. If 10/10 of the sky is covered by fog (a surface-based layer) and 6/10 of the sky can be seen through the fog, the Sky Cover for this layer is _____, and the Sky Cover Symbol used to represent the layer is _____.

4. If the sky is visible everywhere through a layer of smoke that is on the ground covering 10/10 of the sky, the Sky Cover for the smoke layer is_____, and the Sky Cover Symbol used is_____.

5. If the sky is visible everywhere through a layer of smoke aloft that covers 10/10 of the sky, the Sky Cover of the layer is_____, and the Sky Cover Symbol used is _____.

6. If the sky cannot be seen because of a layer of smoke at the surface that hides 10/10 of the sky, the Sky Cover of the layer is _____, and the Sky Cover Symbol used is _____.

7. If 10/10 of the sky is covered by a layer aloft that hides 3/10 of the sky, the Sky Cover of the layer is_____, and the Sky Cover Symbol used is _____.

8. If 7/10 of the sky is covered by a layer aloft that hides 3/10 of the sky, the Sky Cover of the layer is_____, and the Sky Cover Symbol used is _____.

9. If only one layer is present, and it hides half of the sky, the Sky Cover Symbol_____is used if the layer is aloft, and the Sky Cover Symbol_____is used if the layer is surface-based.

10. If only one layer is present, and it hides all of the sky, the Sky Cover Symbol_____is used if the layer is aloft, and the Sky Cover Symbol_____is used if the layer is surface-based.

11. Sky Cover Symbols are entered in column 3 of MF1-10 in _____ (ascending, descending) order of the height of the layers.

ANSWERS TO REVIEW QUESTIONS

1. Hidden. (A5-2.18b)

2. Covered. (A5-2.18a)

3. 4/10; -X (A5-2.18b and table A3-1)

4. 0/10; and layer would not be reported in column 3. (A5-2.18b and table A3-1)

5. 10/10; ⊕ (A5-2.18a and table A3-1)

6. 10/10; X (A5-2.18b and table A3-1)

7. 10/10; ⊕ (A5-2.18a and table A3-1)

8. 7/10; ◍ (A5-2.18a and table A3-1)

9. ⊖; -X (table A3-1)

10. ⊕; X (table A3-1)

11. Ascending. (A3-2.3)

PART II - SKY COVER WITH MULTIPLE LAYERS

READING ASSIGNMENT

Chapter A5 - Read ¶2.1.2, 2.1.3, 2.13, and 2.23.
Chapter A3 - Study ¶2.21.

DISCUSSION

When there are multiple layers visible from the surface, there is one very important rule to remember when determining the Sky Cover for each layer. This rule is that the Sky Cover for any given layer is the total of the sky hidden by any suface-based layer plus the amount of sky covered by all layers aloft from the surface up to and including the layer being evaluated.

Because of this rule, always start evaluating Sky Cover with the lowest layer. This rule also means that as you evaluate the Sky Cover of each new layer, the amount determined must be either equal to, or more than the previously evaluated layer. For example, if the sky was completely covered with clouds in five different layers, and each layer by itself covered 2/10 of the sky, the Sky Cover determined for each of the layers would be:

First layer (lowest)	2/10 Sky Cover
Second layer	4/10 Sky Cover
Third layer	6/10 Sky Cover
Fourth layer	8/10 Sky Cover
Fifth layer	10/10 Sky Cover

Notice that the Sky Cover of the highest layer is considered to be 10/10, even though by itself it is only covering 2/10 of the sky. The reason for this is that Sky Cover is always determined with respect to an observer on the ground. Therefore, at the highest layer in this example, the sky is completely covered when viewed from the ground. If a pilot was flying either in or above the fifth layer, his view of the ground would be obstructed in all directions below him by clouds.

After determining the Sky Cover and Sky Cover Symbol for each layer aloft, enter the symbols in column 3 of MF1-10 in ascending order, and enter the Sky Cover of the highest layer in column 21. If the symbol for the highest layer is ⊕, the entry in column 21 must be 10 (for 10/10 Sky Cover). If the symbol for the highest layer is ⊖, the entry in column 21 must be either 1, 2, 3, 4, or 5. If the sky is clear, the entry would be 0.

In figures 2-3 and 2-4, the Sky Condition is shown as it would appear in column 3 of MF1-10, and as it would be transmitted on a teletypewriter. In each of the illustrations, note how the Sky Cover was determined, and how the symbol was selected. In the lower right-hand corner of each illustration, the correct entry for column 21 is given. The data between the Sky Cover Symbols will be discussed later in this chapter.

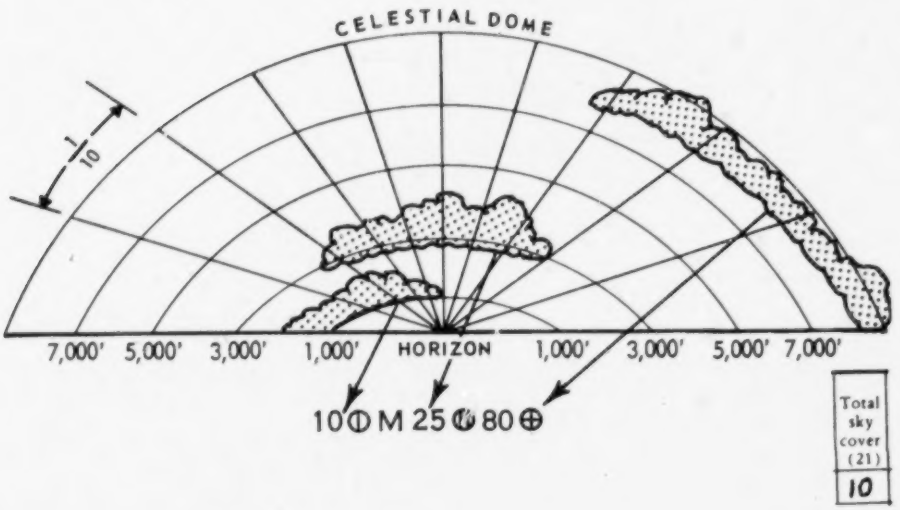


Figure 2-3. In this figure, there are three layers of clouds. The lowest covers 5/10 of the sky and is reported as scattered (⊕). The second layer hides an additional 3/10 of sky (that portion directly above the lower layer is not counted). Therefore, the Sky Cover for the second layer is 5/10 + 3/10 which gives 8/10. Thus, the second layer is reported as Broken (⊕). The highest layer covers an additional 2/10 sky for a Sky Cover of 5/10 + 3/10 + 2/10, or 10/10. Thus it is reported as Overcast (⊕).

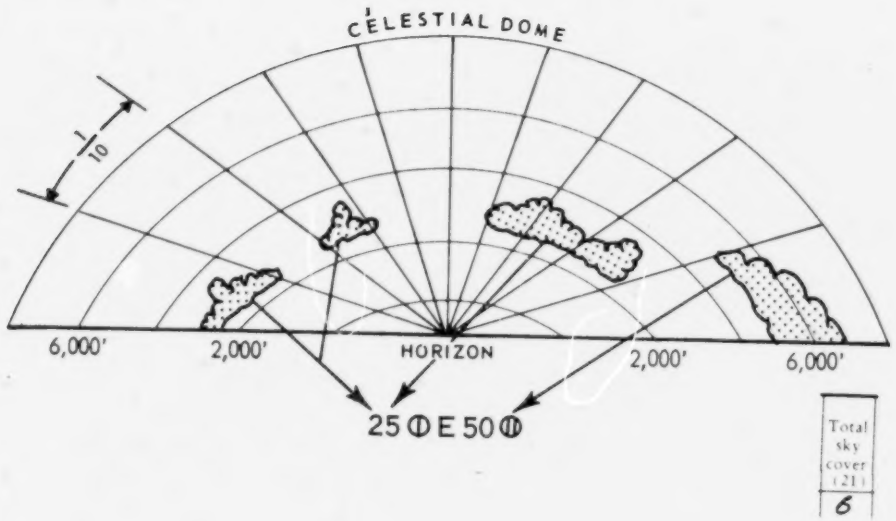


Figure 2-4. Two layers are present. The lower layer covers 5/10 sky and is reported as Scattered (). The higher layer covers 1/10 sky giving a Sky Cover amount for that layer of 5/10 + 1/10 or 6/10. Thus, the higher layer is reported as Broken ().

REVIEW QUESTIONS

For each of the following, enter the Sky Cover Symbols as they would be entered in column 3 of MF1-10, and make the correct entry in column 21.

Observed	MF1-10 Entries Col. 3	Col. 21
1. The lowest layer, based at the surface, hides 6/10 of sky; second layer is aloft and covers 3/10 of sky.		
2. The lowest layer, based at the surface, covers 10/10 of sky and hides 3/10. The second layer is aloft and covers 2/10 of sky. The third layer covers less than 1/10 of sky.		
3. The lowest layer is aloft, covering 6/10 of sky but only hides 3/10 of sky. The second layer covers 2/10 of sky and the third layer covers 1/10.		
4. Two layers of clouds together cover less than 1/10 of sky.		
5. At the surface, fog hides 9/10 of sky; aloft the remaining 1/10 of sky is covered by a higher layer.		
6. Four layers, all aloft; the lowest covers 1/10 of sky, the second and third each cover 3/10 of sky, the fourth and highest covers 2/10 of sky.		
7. Fog at the surface covers 4/10 of sky and hides 1/10 of sky; two higher layers each cover 3/10 of sky.		
8. Less than 1/10 of the sky is hidden by a layer overhead, otherwise the sky is clear.		

9. Smoke at the surface hides 3/10 of sky; above the smoke, the sky is clear. _____

10. Smoke at the surface covers 10/10 of the sky, above the smoke, the sky is clear. _____

ANSWERS TO REVIEW QUESTIONS

1. -X ⊕ ,9
2. -X ⊖ ⊖ ,5
3. ⊕ ⊕ ⊕ ,9
4. O ,0
5. -X ⊕ ,10
6. ⊖ ⊖ ⊕ ⊕ ,9
7. -X ⊖ ⊕ ,7
8. O ,0
9. -X ,3
10. O ,0

(For all questions see ¶A5-2.18, 2.23, A3-2.3, 2.21, and table A3-1.)

PART III - CHARACTER OF SKY COVER

READING ASSIGNMENT

Chapter A5 - Read §2.14, 2.15, 2.10, and 2.21.
Chapter A3 - Study §2.36; memorize table A3-1.

DISCUSSION

In addition to determining the Sky Cover for each layer visible from the station, the Character of the Sky Cover must be determined for each layer that is aloft. That is, each layer aloft must be classified as either "thin," or "opaque." If the Sky Cover for a layer is classified as thin, the Sky Cover Symbol for the layer is prefixed with a minus sign, e.g., -Φ. If the Sky Cover for a layer is classified as opaque, the Sky Cover Symbol is used without a prefix.

To determine the Character of the Sky Cover, as you determine the Sky Cover for each layer, also determine the Opaque Sky Cover for each layer. This is done the same way as Sky Cover, except that only that portion of Sky Cover which prevents you from seeing the sky or higher layers is counted for Opaque Sky Cover. For example, if a layer aloft covers 7/10 of sky, and only hides 3/10 of the sky, the Sky Cover is 7/10, and the Opaque Sky Cover is 3/10. Like Sky Cover, Opaque Sky Cover for any layer is the Opaque Sky Cover caused by all layers up to and including the layer being evaluated. For example, if 2/10 of sky is hidden by one layer and 3/10 of sky is hidden by a second layer, the Opaque Sky Cover of the first layer would be 2/10 and the Opaque Sky Cover for the second layer would be 2/10 + 3/10 = 5/10.

When determining Sky Cover and Opaque Sky Cover, do not count as Sky Cover that portion of layers seen through lower layers. However, include that portion of sky that is hidden by higher layers seen through lower layers when determining Opaque Sky Cover for the higher layer. Under these conditions, the higher layer is not counted as Sky Cover because that area of the sky is already covered by a lower layer, and once an area of the sky is covered, it is covered. For example, if two layers of clouds are present, the lower layer covering 10/10 of the sky while hiding none of the sky, the second layer hiding 6/10 of sky, the lower layer would have a Sky Cover of 10/10, and an Opaque Sky Cover of 0/10. The higher layer would have a Sky Cover of 10/10 + 0/10 = 10/10, and an Opaque Sky Cover of 0/10 + 6/10 = 6/10.

Once the Sky Cover and Opaque Sky Cover are determined for each layer, determine which layers aloft should be classified as thin, and place a minus sign in front of the Sky Cover Symbols of those layers. The easiest way to determine whether or not to use the minus with a symbol is to make a fraction out of the Sky Cover and Opaque Sky Cover of each layer as you

observe them. Use the tenths of Opaque Sky Cover as the numerator, and the tenths of Sky Cover for the denominator. The denominator (Sky Cover) of the fraction will tell you what symbol to use for the layer, and the whole fraction will tell you whether or not to use the minus sign. If the fraction is greater than 1/2, do not use the minus sign. If the fraction is equal to or less than 1/2, prefix the symbol for the layer with a minus sign.

EXAMPLE: First layer (aloft), covers 3/10 sky, hides 2/10 sky.
Second layer covers 2/10 sky, hides none.
Third layer covers 4/10 sky, hides 3/10 sky.
Fourth layer covers 1/10 sky, hides none.

First layer = $\frac{\text{Opaque Sky Cover}}{\text{Sky Cover}} = \frac{2\text{ (tenths)}}{3\text{ (tenths)}} = \frac{2}{3} =$ ⊕ Since the denominator is 3, the symbol is ⊕ and since 2/3 is greater than 1/2, a minus is not used.

Second layer = $\frac{\text{Opaque Sky Cover}}{\text{Sky Cover}} = \frac{2+0}{3+2} = \frac{2}{5} =$ -⊕ Denominator is 5 means ⊕, and 2/5 being less than 1/2 indicates the use of a minus.

Third layer = $\frac{\text{Opaque Sky Cover}}{\text{Sky Cover}} = \frac{2+0+3}{3+2+4} = \frac{5}{9} =$ ⊕ Denominator 9 indicates ⊕, and since 5/9 is greater than 1/2, a minus is not used.

Fourth layer = $\frac{\text{Opaque Sky Cover}}{\text{Sky Cover}} = \frac{2+0+3+0}{3+2+4+1} = \frac{5}{10} =$ -⊕ Denominator 10 indicates ⊕, and since 5/10 = 1/2, a minus sign is used.

Remember when using this method, it can only be used for layers aloft. When a layer is based at the surface, a -X is used if the layer hides some but not all the sky, and X is used only if the layer hides all of the sky.

EXAMPLE: First layer is fog on the surface hiding 3/10 of sky.
Second layer covers 2/10 of sky, hides none.
Third layer covers 3/10 of sky, hides none.

First layer = 3/10 Sky Cover and Opaque Sky Cover = -X

$$\text{Second layer} = \frac{\text{Opaque Sky Cover}}{\text{Sky Cover}} = \frac{3+0}{3+2} = \frac{3}{5} = \text{Φ}$$

$$\text{Third layer} = \frac{\text{Opaque Sky Cover}}{\text{Sky Cover}} = \frac{3+0+0}{3+2+3} = \frac{3}{8} = -\text{Φ}$$

The fraction determined for the highest layer visible also provides the correct entries for columns 21 and 36 of MF1-10. The entry in column 21 is the Total Sky Cover, i.e., the tenths of sky that is covered by all layers present. This value is the denominator of the fraction. The entry in column 36 is the Total Opaque Sky Cover, i.e., the tenths of sky hidden by all layers present. This value is the numerator of the fraction for the highest layer.

Study the following illustrations carefully. Try to determine the Sky Cover Symbol and Character for each layer, and the correct entries for columns 21 and 36. After you have done this, read the discussion following each illustration and try to understand the procedure used to determine the data.

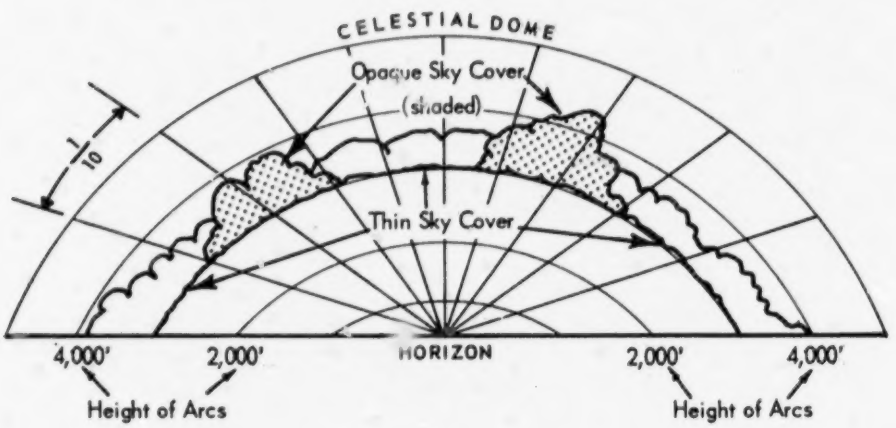


Figure 2-5. Construction of Sky Cover Illustrations.

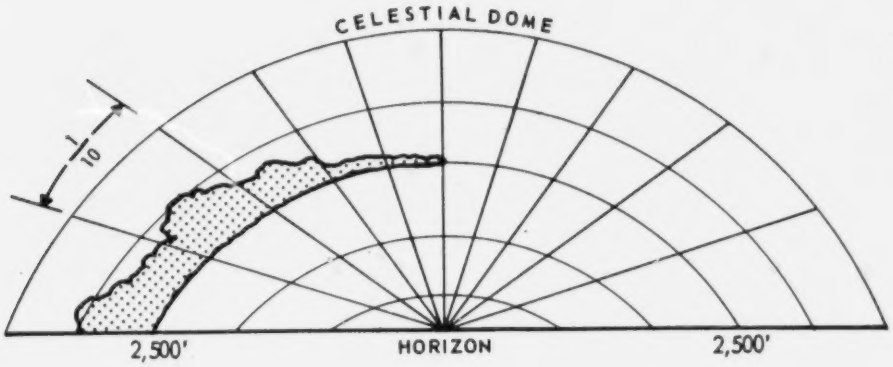


Figure 2-6

Figure 2-6 illustrates the simple case of a single layer aloft, all opaque. The Sky Condition is evaluated as follows:

$$\frac{\text{Opaque Sky Cover}}{\text{Sky Cover}} = \frac{5}{5} = \Phi$$

The denominator 5 (tenths) indicates that the layer is scattered so the symbol Φ is used. Since the fraction 5/5 is greater than 1/2, the minus sign is not used. The entries in columns 21 and 36 are both 5.

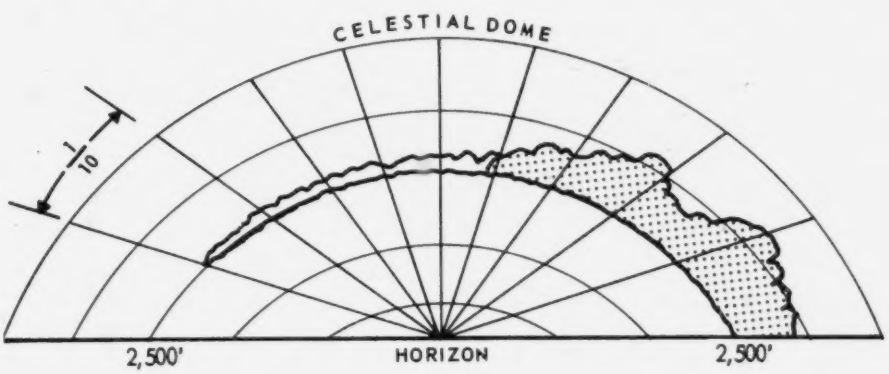


Figure 2-7

Figure 2-7 also illustrates a single layer. However, this layer is partly transparent, and partly opaque. The Sky Condition is evaluated as follows:

$$\frac{\text{Opaque Sky Cover}}{\text{Sky Cover}} = \frac{4}{9} = -\text{◐}$$

The denominator indicates that the layer is broken so the symbol ◐ is used. Since 4/9 is less than 1/2, a minus sign is placed in front of the Sky Cover Symbol. The layer then is termed "thin broken" and reported as -◐. The entries in columns 21 and 36 are 9 and 4, respectively.

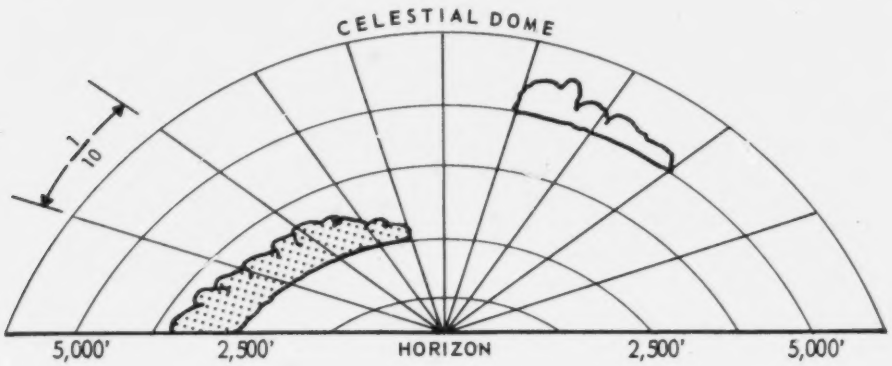


Figure 2-8

Figure 2-8 illustrates two layers and are evaluated as follows:

$$\text{First layer} = \frac{\text{Opaque Sky Cover}}{\text{Sky Cover}} = \frac{4}{4} = \text{●}$$

$$\text{Second layer} = \frac{\text{Opaque Sky Cover}}{\text{Sky Cover}} = \frac{4+0}{4+2} = \frac{4}{6} = \text{◐}$$

The entries in columns 21 and 36 are 6 and 4, respectively.

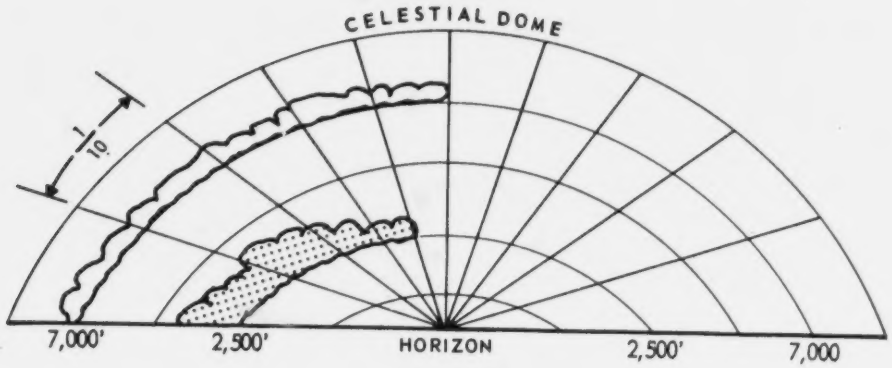


Figure 2-9

Figure 2-9 illustrates two layers, one directly above the other, and is evaluated as follows:

$$\text{First layer} = \frac{\text{Opaque Sky Cover}}{\text{Sky Cover}} = \frac{4}{4} = ⓪$$

$$\text{Second layer} = \frac{\text{Opaque Sky Cover}}{\text{Sky Cover}} = \frac{4+0}{4+1} = \frac{4}{5} = ⓪ .$$

The entries in columns 21 and 36 are 5 and 4, respectively. Note that the 4/10 of the higher layer that is above the lower opaque layer is not included in the Sky Cover of the higher layer.

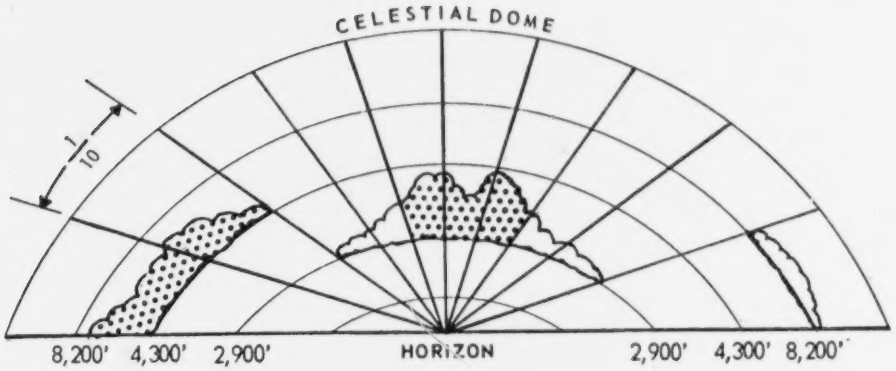


Figure 2-10

Figure 2-10 illustrates three layers of varying opacity and is evaluated as follows:

$$\text{First layer} = \frac{\text{Opaque Sky Cover}}{\text{Sky Cover}} = \frac{3}{7} = -\text{◍}$$

$$\text{Second layer} = \frac{\text{Opaque Sky Cover}}{\text{Sky Cover}} = \frac{3+2}{7+2} = \frac{5}{9} = \text{◍}$$

$$\text{Third layer} = \frac{\text{Opaque Sky Cover}}{\text{Sky Cover}} = \frac{3+2+0}{7+2+1} = \frac{5}{10} = -\oplus$$

The correct entries in columns 21 and 36 are 10 and 5, respectively.

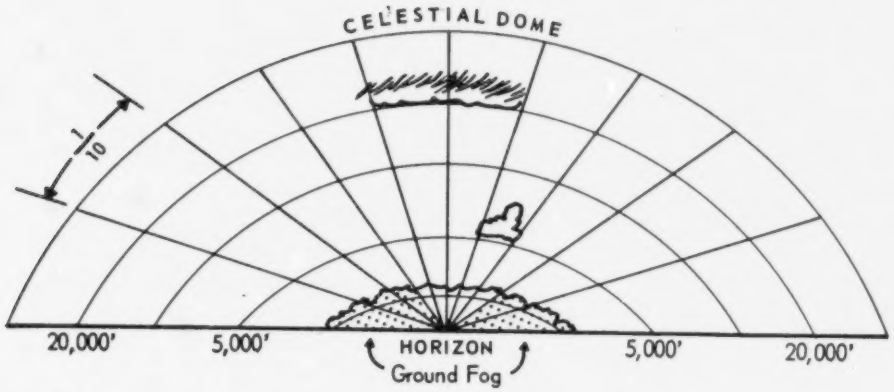


Figure 2-11

Figure 2-11 illustrates three layers, the lowest being on the surface. It is evaluated as follows:

First layer = 5/10 Sky Cover and Opaque Sky Cover (the thin portion that can be seen through is not counted). The symbol is -X.

$$\text{Second layer} = \frac{\text{Opaque Sky Cover}}{\text{Sky Cover}} = \frac{5+0}{5+1} = \frac{5}{6} = ⓫$$

$$\text{Third layer} = \frac{\text{Opaque Sky Cover}}{\text{Sky Cover}} = \frac{5+0+0}{5+1+2} = \frac{5}{8} = ⓲$$

The correct entries in columns 21 and 36 are 5 and 8, respectively. Note that the amount of Sky Cover given to the surface-based layer is used in higher layers both as Sky Cover and Opaque Sky Cover.

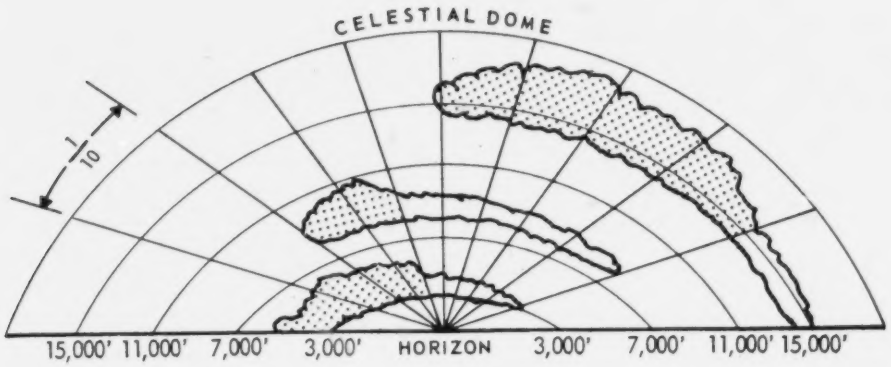


Figure 2-12

Figure 2-12 illustrates three overlapping layers and is evaluated as follows:

$$\text{First layer} = \frac{\text{Opaque Sky Cover}}{\text{Sky Cover}} = \frac{4}{9} = -\text{⏀}$$

$$\text{Second layer} = \frac{\text{Opaque Sky Cover}}{\text{Sky Cover}} = \frac{4+0}{9+0} = \frac{4}{9} = -\text{⏀}$$

$$\text{Third layer} = \frac{\text{Opaque Sky Cover}}{\text{Sky Cover}} = \frac{4+0+4}{9+0+1} = \frac{8}{10} = \oplus$$

The correct entries in columns 21 and 36 are 10 and 8, respectively. Note that the second layer does not increase either the Sky Cover or Opaque Sky Cover of the lower layer. Also note that the 4/10 of the highest layer that is above the thin portions of the other two layers is used to increase the Opaque Sky Cover of the layer but is not used in summing up the Sky Cover.

REVIEW QUESTIONS

In each of the following questions, determine the Sky Cover Symbols and Character for each layer, the correct entries in columns 21 and 36, and make the entries in the spaces provided as they would be made on MF1-10.

1. Fog (surface-based) hides 6/10 of sky. Above the fog, 3/10 of opaque clouds are observed.

   Col. 3 _____ Col. 21 _____ Col. 36 _____

2. A layer of smoke aloft covers 7/10 of the sky. Above the smoke 3/10 of opaque clouds are observed.

   Col. 3 _____ Col. 21 _____ Col. 36 _____

3. Fog (surface-based) covers all but hides none of the sky. Through the fog a layer of clouds covering 5/10 of sky is observed to hide 2/10 of the sky.

   Col. 3 _____ Col. 21 _____ Col. 36 _____

4. A layer aloft covering 3/10 of sky hides 1/10 sky. A higher layer covering an additional 3/10 of sky hides 2/10 sky. A third layer covering still another 3/10 of the sky hides 2/10 sky. A fourth layer all transparent, covers the remainder of the sky.

   Col. 3 _____ Col. 21 _____ Col. 36 _____

5. A layer of haze aloft, covering all of the sky hides 3/10 of sky. Above the haze, a layer of opaque clouds hides 2/10 sky.

   Col. 3 _____ Col. 21 _____ Col. 36 _____

ANSWERS TO REVIEW QUESTIONS

	Col. 3	Col. 21	Col. 36
1.	-X ◍	,9	9
2.	-◍ -⊕	10	3
3.	-◍	5	2
4.	◍ -◍◍ -⊕	10	5
5.	-⊕ -⊕	10	5

(For all questions see ¶A5-2.18, 2.14, 2.15, A3-2.3, 2.21, 2.36, and table A3-1.)

PART IV - CLOUD AND CEILING HEIGHTS

READING ASSIGNMENT

Chapter A5 - Read ¶2.2 thru 2.5.6, 2.10, 2.16, 2.24, 2.25, 3.7 thru 3.7.6, 4.1, and 4.1.1.
Chapter A3 - Study ¶2.3.2, 2.3.3,and tables A3-2 and 3.
Chapter A2 - Memorize ¶3.7.2a and b.
Chapter B2 - Read ¶2.1 thru 2.3.3.

DISCUSSION

When it is possible to measure the height of clouds, determining the height is not much of a problem. However, you will have to estimate cloud heights quite often. This will be necessary when the clouds are beyond the limits of the system available for measuring them, when instruments are inoperative, when clouds are scattered, etc. This estimation is especially difficult for the new observer. Figures 2-13A, B, and C are presented to help you make this estimate.

Clouds are grouped into three families according to the height at which they are generally found. Figures 2-13A, B, and C depict the most common types of clouds found in each of these families. At the foot of each figure, there is a small diagram that indicates the range of heights associated with the clouds in the figure. The range of heights is indicated by the shaded area in the figure. Latitudes are given along the bottom of the height diagram and heights are given along each side. When using these figures as guides, use the height range indicated by the shaded area above the approximate latitude of your station. In the summer, the average height of clouds will tend to be higher in the indicated range than in the winter.

The height of the base of each layer aloft is prefixed to the Sky Cover Symbol representing that layer. Record the heights by rounding them to the nearest reportable value and dropping the last two zeros. For example, a thin broken layer at 23,451 feet would be recorded as 230-◐. The recorded height was determined by rounding 23,451 feet to 23,000 feet and dropping the last two zeros.

No height is assigned to a surface-based layer, unless it completely hides the sky. In other words, heights are never reported for a layer reported as -X.

When the sky is completely hidden by surface-based phenomena, such as fog or precipitation, the height ascribed to the surface-based layer is really the Vertical Visibility into the layer. This Vertical Visibility can be the distance a ceiling light beam penetrates into the layer; the height at which a balloon completely fades from sight; or the height at which a pilot reports that he can see the ground. If you lack these guides, estimate the Vertical Visibility on the basis of experience.

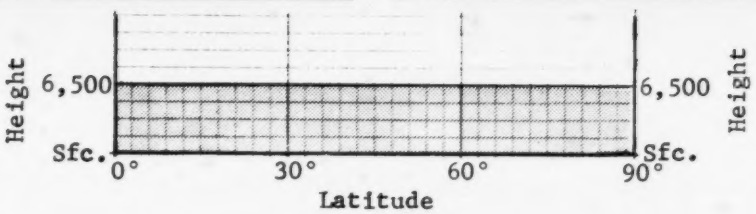


Figure 2-13A. Low Clouds.

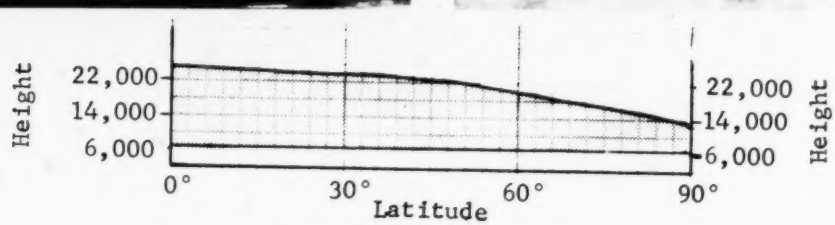
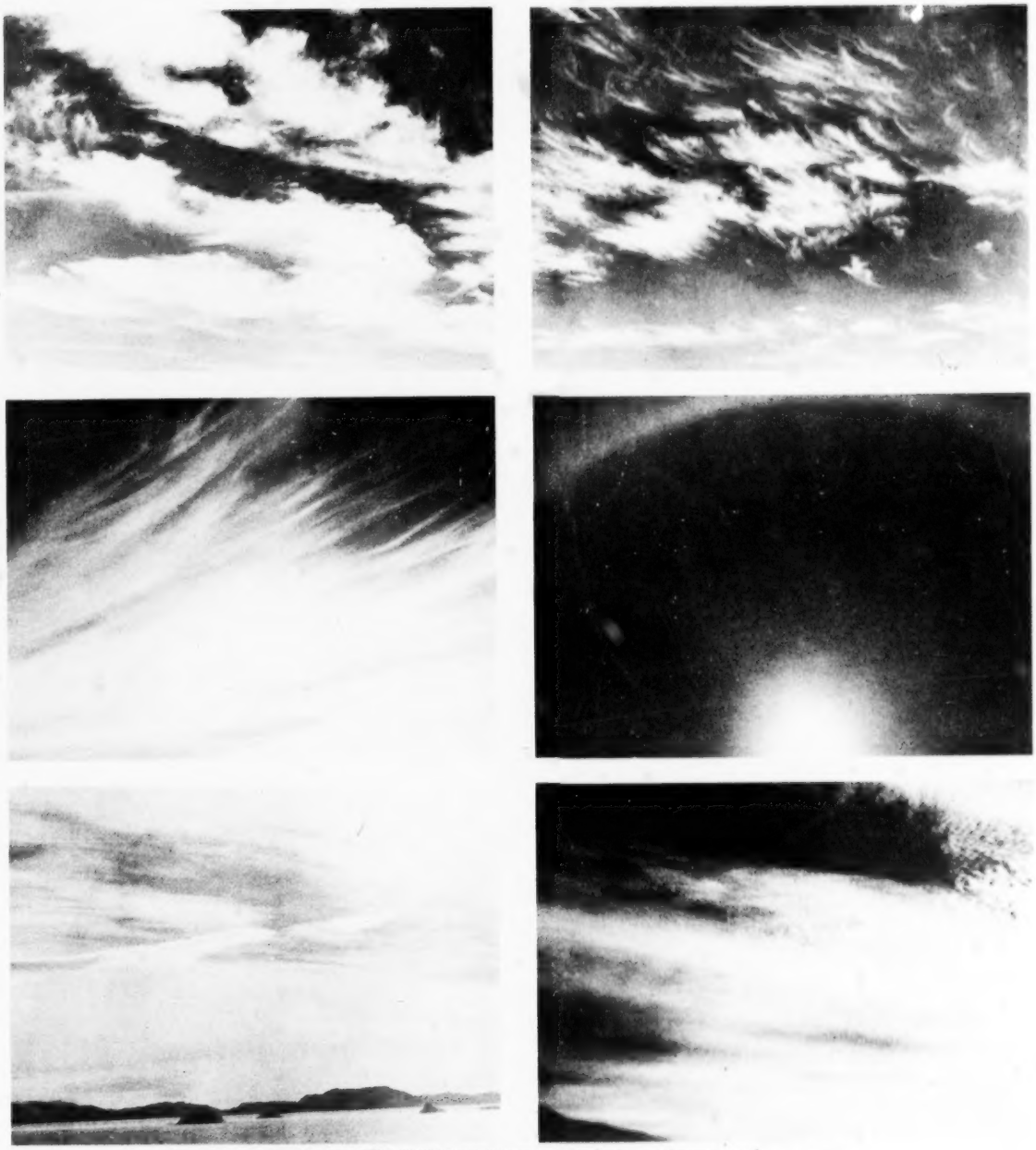


Figure 2-13B. Middle Clouds.



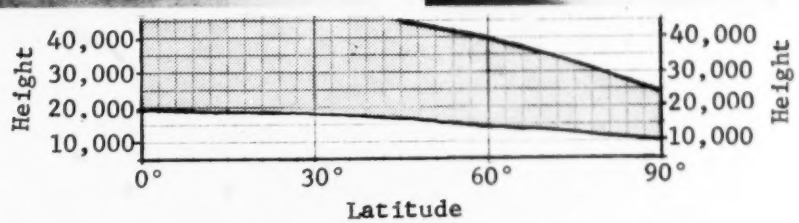


Figure 2-13C. High Clouds.

Once you have determined the amount, character, and height of each layer present at the station, there is just one step left. That is to determine the Ceiling. If you have learned to evaluate Sky Cover, and can record it correctly, then determining the Ceiling is very easy. The Ceiling is the lowest layer reported as X, ⊕, or ⊕ and not prefixed with a minus sign. The Ceiling is indicated in the report by prefixing the height of the Ceiling layer with a letter called a Ceiling Designator.

Determining which Ceiling Designator to use is quite simple. If the Ceiling is a surface-based layer, that is the Sky Cover Symbol for the layer is an X (not -X), always use the Ceiling Designator W. This designator indicates to the user that the height being reported for the layer is the Vertical Visibility into a phenomenon on the ground and is not a cloud height. Figure 2-14 illustrates one reason why this differentiation is important. Another reason is that as a pilot descends through the layer, and goes below the reported Ceiling, he may encounter clouds that are unreported because they are not visible to the observer.

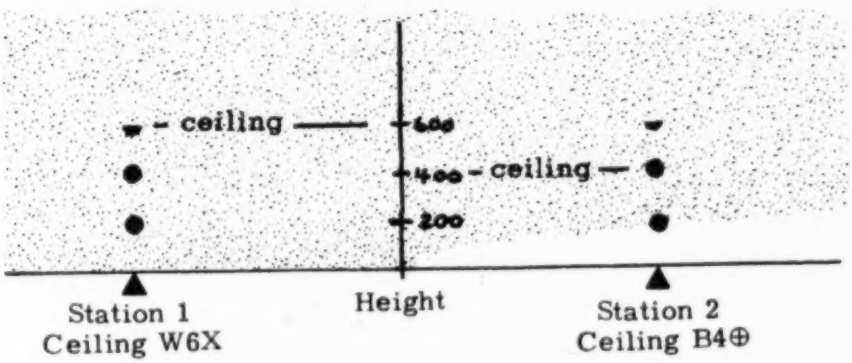


Figure 2-14. In this illustration the cloud deck is aloft at Station 2 and at the surface at Station 1. At Station 1 the balloon starts to fade immediately and disappears from sight at 600 feet. Since the phenomenon is surface-based, the height of the Ceiling is the Vertical Visibility into the phenomenon and, therefore, is reported as W6X. At Station 2 the balloon starts to fade when it enters the cloud base at 200 feet and disappears from sight at 600 feet, but since the phenomenon is aloft, the Ceiling Height reported is the midpoint between where the balloon enters the cloud base and where it completely disappears, i.e., B4⊕.

When the Ceiling is caused by a layer aloft, the method used to determine the height of that layer determines the letter to be used. Figure 2-15 gives the various methods of determining the heights of layers aloft, the associated Ceiling Designator, and the limitations on the use of the Ceiling Designators.

Method of Determining the Height	Designator to use	Limitations on Use
Ceiling light	M	Heights must be less than 10 times the baseline.
Known heights of objects	M	Measured within 1 1/2 miles of a runway of the airport.
Pilot report	A	Height observed by pilot within 1 1/2 nautical miles of a runway of the airport and within 15 minutes of the actual time of the observation for noncirriform layers and 50 nautical miles and 1 hour for cirriform layers.
By timing ceiling balloon	B	Not used at night or during moderate or heavy precipitation (except drizzle) or during hail, ice pellets or freezing rain of any intensity.

Figure 2-15. Ceiling Designators for layers aloft.

If none of the above methods are used, within the limitation on their use, or if you do not believe they are reliable, use the letter E to indicate that the Ceiling is estimated. Remember that regardless of how the Vertical Visibility is determined, the Ceiling Designator W is used.

There will be times when it is hard to determine a single height for a layer. This is when the cloud height is varying rapidly while you are trying to get a height. When this happens, report the average of all observed values as the height of the layer. If it happens to be the Ceiling layer, and the average height turns out to be less than 3,000 feet, put a V between the height and the related Sky Cover Symbol, e.g., E20V⊕. Remember that the V indicates that the height is variable and does not indicate the Ceiling. This means that a Ceiling will be classified as A, B, M, E, or W in addition to having the V in the report. For example, an overcast Ceiling which is determined to be variable at 1,500 feet by using a ceiling light, would be reported as M15V⊕.

REVIEW QUESTIONS

1. A Ceiling is defined as _____
_____.

2. How should each of the following observed heights be recorded in column 3 of MF1-10?

   a. 175 feet _____

   b. 11,250 feet _____

   c. 7,750 feet _____

   d. 50 feet _____

   e. 725 feet _____

   f. 2,651 feet _____

3. If 9/10 of the sky was hidden by a surface-based phenomenon, would this layer ever be used as the Ceiling?

4. The heights of all layers, including the Ceiling layer, will be recorded in column 3 of MF1-10 in terms of feet above _____.

5. A broken layer at a measured 2,500 feet, and an overcast layer at an estimated 18,000 feet (both opaque) would be recorded in column 3 of MF1-10 as _____.

6. A pilot reports the height of an overcast layer at 900 feet within 1 1/2 miles of the runway and less than 15 minutes before the observation. The height of the field is 180 feet. If this layer is the Ceiling, it would be entered in column 3 of MF1-10 as _____.

7. For each of the following, indicate the Ceiling Designator that should be used if the ceiling height was determined as indicated.

   a. A balloon was used with a light attached. _____

   b. A balloon was used when light rain was falling. _____

   c. A ceiling light with a baseline of 500 feet indicated a height of 5,500 feet. _____

   d. The ceiling light intersected a transmitting antenna within 1 1/2 miles of the airport. _____

e. A ceiling light with a baseline of 800 feet gives a ceiling measurement of 6,500 feet. _____

f. The intersection of the ceiling layer with a hill 3 miles away. _____

g. A balloon was used when heavy drizzle was falling. _____

h. A balloon was used to determine the Vertical Visibility into fog that was completely hiding the sky. _____

i. A balloon was used to measure the height during moderate rain. _____

j. A pilot reports the base of the layer 10 minutes before the observation and 1 mile from the runway. _____

8. An overcast layer of clouds, all opaque, is present over the field. A balloon is released and the observer notes that the balloon begins to fade at 1,800 feet and completely fades from view at 2,100 feet. This Sky Condition would be entered in column 3 of MF1-10 as: _____

9. The sky is completely obscurred (hidden) by a layer of fog at the surface. The observer releases a balloon to determine the ceiling height and notes that the balloon starts to fade almost immediately, and completely fades from view at 650 feet. This Sky Condition would be entered in column 3 of MF1-10 as: _____

10. When several layers are reported as broken or overcast, and are not thin, the Ceiling is the _____ layer in the report.

For each of the following observed Sky Conditions, make the entries as they would be made in column 3, 21, and 36 of MF1-10.

11. Fog hiding 4/10 sky (Fog by definition is always surface-based). Clouds covering 2/10 sky at a measured 500 ft. hide none of the sky. Clouds covering 4/10 sky at an estimated 25,000 ft. hide 1/10 sky.

Col. 3 _____ Col. 21 _____ Col. 36 _____

12. Clouds covering 6/10 sky at an estimated 12,000 ft. hide 5/10 sky. Clouds covering and hiding less than 1/10 sky at an estimated 25,000 ft.

Col. 3 _____ Col. 21 _____ Col. 36 _____

13. Clouds covering less than 1/10 sky at an estimated 2,500 ft. Clouds covering less than 1/10 sky at an estimated 25,000 ft.

Col. 3 _____ Col. 21 _____ Col. 36 _____

14. Clouds covering less than 1/10 sky at an estimated 1,000 ft. Clouds covering and hiding 3/10 sky at a measured 3,000 ft. Clouds covering less than 1/10 sky at an estimated 9,000 ft.

Col. 3 _____ Col. 21 _____ Col. 36 _____

15. Sky is totally obscured by snow. Vertical Visibility is determined to be 500 ft. by use of a ceiling balloon.

Col. 3 _____ Col. 21 _____ Col. 36 _____

16. Fog hides 3/10 sky. Clouds covering 5/10 sky at a measured 400 ft. hide 1/10 sky. Clouds covering 2/10 sky at an estimated 15,000 ft. hide 2/10 sky.

Col. 3 _____ Col. 21 _____ Col. 36 _____

17. Clouds covering and hiding 1/10 sky at an estimated 800 ft. Clouds covering 7/10 sky at an estimated 22,000 ft. hide 2/10 sky.

Col. 3 _____ Col. 21 _____ Col. 36 _____

18. Fog hides 9/10 sky, no clouds visible.

Col. 3 _____ Col. 21 _____ Col. 36 _____

19. Fog hiding 9/10 sky. Clouds covering and hiding less than 1/10 sky at an estimated 1,800 ft.

Col. 3 _____ Col. 21 _____ Col. 36 _____

20. Fog hides 2/10 sky. Clouds covering 4/10 sky at 900 ft. (determined by balloon) hide 2/10 sky. Clouds covering 2/10 sky at an estimated 8,000 ft. hide 1/10 sky.

Col. 3 _____ Col. 21 _____ Col. 36 _____

21. Clouds covering 10/10 sky at a measured 400 ft. hides 6/10 sky. Clouds hiding 4/10 sky at an estimated 7,600 ft. (baseline is 800 ft.)

Col. 3 _____ Col. 21 _____ Col. 36 _____

22. Clouds hiding 10/10 sky intersect a transmitting antenna 2 miles from the runway at 320 ft.

    Col. 3 _____ Col. 21 _____ Col. 36 _____

23. Clouds covering 10/10 sky at an estimated 25,000 ft. hide 4/10 sky.

    Col. 3 _____ Col. 21 _____ Col. 36 _____

24. Fog hiding 2/10 sky. Clouds covering 8/10 sky at an estimated 2,500 ft. hide 4/10 sky.

    Col. 3 _____ Col. 21 _____ Col. 36 _____

25. Fog hiding 1/10 sky. Clouds covering 3/10 sky at an estimated 1,000 ft. hide 1/10 sky. Clouds covering 4/10 sky at an estimated 5,000 ft. hide 3/10 sky. Clouds covering 2/10 sky at an estimated 18,000 ft. hide 0/10 sky.

    Col. 3 _____ Col. 21 _____ Col. 36 _____

ANSWERS TO REVIEW QUESTIONS

1. The lowest layer reported as X, ⌀, or ⊕ and not classified as thin. (A3-2.3.3)

2. a. 2

   b. 110

   c. 75

   d. 0

   e. 7

   f. 27 (table A3-2)

3. No (A3-2.3.3)

4. The surface or field elevation (A3-2.3.2)

5. M25⌀180⊕ (A3-2.3 thru 2.3.3)

6. A7⊕ (A3-2.3 thru 2.3.3 and A5-3.7.1)

7. a. E (A5-3.7.2.1c)

b. B (A5-3.7.2.1)

c. E (A5-3.7.3f)

d. M (A5-3.7.4b)

e. M (A5-3.7.4a)

f. E (A5-3.7.3b)

g. B (A5-3.7.2.1)

h. W (A5-3.7.6)

i. E (A5-3.7.2.1c)

j. A (A5-2.5.1)

8. B19⊕ (A5-3.7.2.1, A3-2.3 thru 2.3.3)

9. W6X (A5-3.7.2.1)

10. Lowest (A5-2.2)

(For the remaining questions A5-3.5, A3-2.3 thru 2.3.3, 2.21, and 2.36, and tables A3-1, A3-2, and A3-3.)

	Col. 3	Col. 21	Col. 36
11.	-XM5Φ250-⊕	10	5
12.	E120Φ250Φ	6	5
13.	O	0	0
14.	30Φ90Φ	3	3
15.	W5X	10	10
16.	-X4-ΦE150⊕	10	6
17.	8Φ220-Φ	8	3
18.	-X	9	9
19.	-XE18Φ	9	9

20.	-XB9⌀80⌀	8	5
21.	M4⊕	10	10 (see WSOH No. 4, Table A3-1)
22.	E3⊕	10	10
23.	250-⊕	10	4
24.	-XE25⊕	10	6
25.	-X10-⌀E50⌀180-⊕	10	5

PART V - REMARKS AND SPECIAL CRITERIA

READING ASSIGNMENT

Chapter A5 - ¶2.22, 3.8, and 3.9.
Chapter A3 - Read table A3-15, study ¶2.13.4, 2.13.7, and 2.13.8a.

DISCUSSION

You should be familiar enough with the instructions in the reading assignment to recognize a situation which requires a Remark. Until you are completely familiar with the instructions for the Remarks, or whenever in doubt, you should refer to the instructions for the details. Some of the more important Remarks are discussed in the following paragraphs.

Variable Ceiling. As stated before, whenever the height of the Ceiling rapidly increases and decreases by one or more reportable values and the average height is less than 3,000 feet, a V is inserted in front of the Sky Cover Symbol. So that a user can determine just how variable the Ceiling is, a Remark is added to the weather report as follows: CIG, followed by the minimum observed height, the letter V, followed by the maximum observed height, e.g., the Remark CIG8V10 indicates a Ceiling varying between 800 and 1,000 feet. When entering this Remark, use the highest and lowest heights observed in the past 15 minutes.

Sky Cover Attributed to Obscuring Phenomena Aloft. A layer of clouds at 200 feet and a layer of smoke at 200 feet might indicate two different situations to a pilot inbound to your station, yet in the Sky Condition portion of the coded report they would both appear as 2⌀ or something similar. So that the report is not misleading, include a Remark in the weather report to indicate that a layer aloft consists of an obscuring phenomenon. To do this, enter the symbol for the type of phenomenon, the height, and the Sky Cover Symbol. For example, the Remark H7-⌀ indicates that the thin broken layer reported at 700 feet is composed of haze.

Amount of Partial Obscuration. Whenever -X is reported in the Sky Condition, it means that part of the sky is hidden by some surface-based phenomenon. How much? Is it 1/10, 5/10, or 9/10? To clarify the -X report, report the tenths of the sky hidden by the surface-based phenomena in Remarks. Do this by entering the symbol for the type of phenomenon followed by the amount of sky hidden. If more than one type is present, such as fog and smoke, enter the symbol for both. Some examples are: F8 - indicating 8/10 of the sky hidden by fog; K2 - indicating that 2/10 of the sky is hidden by smoke; RS6 - indicating 6/10 of the sky hidden by a combination of rain and snow. When the phenomenon causing the obscuration is a form of precipitation, do not use the intensity symbols in this Remark (see table A3-15 in WSOH No. 4 for correct symbols for this Remark).

Significant Cloud Types. Certain types of clouds are of particular importance to pilots. You are expected to be able to recognize these. The following figures contain a picture and description of each of these cloud types and an illustration of the associated Remark.

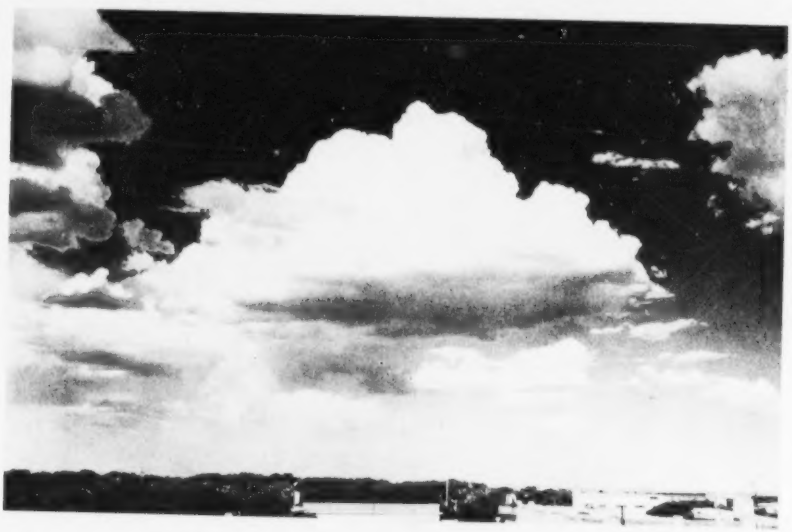


Figure 2-16. Towering Cumulus. This cloud is similar to "fair weather cumulus" but has a distinctly shaded, often dark, base. Report TCU followed by the direction from the station, e.g., TCU NW or LRG TCU OVHD.

Figure 2-17. Cumulonimbus without anvil.

Figure 2-18. Cumulonimbus with anvil. These are large cumulus type clouds with dark bases and are threatening in appearance. Report CB followed by direction from station and if known, the movement of the cloud, e.g., CB SE MOVG N or LN CB SW-NW MOVG E.

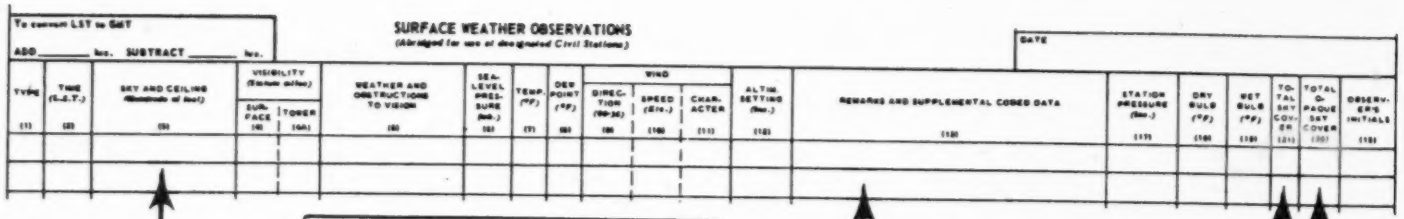
Figure 2-19. Cumulonimbus Mamma. This is a dark cloud with rounded protuberances hanging downward from its base. Report CBMAM followed by the direction from the station, and if known, the direction of movement of the cloud, e.g., CBMAM ALQDS MOVG N.

Figure 2-20. Altocumulus Castellanus. These clouds are similar to cumulus clouds but are at a higher level and are usually smaller. Report ACCAS followed by the direction from the station, e.g., ACCAS N-E.

Figure 2-21. Standing Lenticular. These clouds usually form in patches in the shape of plates, saucers, lens, etc. They typically form on the lee side of mountains or ridges and are often observed at several levels. Report ACSL followed by the direction from the station, e.g., ACSL SW.

Figure 2-22. Rotor Clouds. These clouds form on the lee side of mountains or ridges. Report ROTOR CLDS followed by direction from station, e.g., ROTOR CLDS NW-N.

Before going on to the review questions, study figure 2-28. That figure illustrates the entry of Sky Condition and related Remarks on MF1-10C, and summarizes the rules for making the entries.



Entries are made in column 3, and if appropriate, in column 13 for all observations except single element Specials.

Sky Condition Visible to Observer

Remarks

Total Opaque Sky Cover

For each observation, enter the tenths of the sky hidden by all clouds and obscuring phenomena.

Total Sky Cover

For each observation, enter the tenths of sky covered by all layers aloft, plus the tenths of sky hidden by surface-based layers.

SKY COVER SYMBOLS

0-1/10	○ 10/10	⊕
1/10-5/10	◑ Obscured	X
6/10-9/10	◍ Partly obscured	-X

Prefix ◑, ◍, or ⊕ symbols with a minus if layer is classified thin.

Enter symbol for each layer up to and including the first ⊕ layer not classified thin.

HEIGHTS

Enter height above field for each X, ◑, ◍, or ⊕ layer. Encode heights in hundreds of feet as follows:
0-5,000', to nearest 100'
5,000-10,000', to nearest 500'
above 10,000', to nearest 1,000'.

If height of Ceiling is variable, and less than 3,000 feet, enter a V between height and Sky Cover Symbol.

CEILING DESIGNATORS
(for layers aloft)

Measured	M	Balloon	B
Aircraft	A	Estimated	E

(for surface-based layers) always use W

Enter a Ceiling Designator, as a prefix, to the height of the lowest X, ◑, or ⊕ layer not classified thin.

Whenever a -X is entered in column 3, enter the type of phenomenon hiding the sky, and the amount of sky hidden. Make this the first entry in column 13.

Breaks in overcast	BINOVC (direction); e.g., BINOVC S
Clouds above overcast	HIR CLDS VSB
Breaks in broken layer below 1,000 ft.	BRKS (direction); e.g., BRKS SW. (omit if breaks in all directions)
Obscuring phenomena aloft	(Type)(height)(Sky Cover Symbol); e.g., K2-◍
Towering cumulus	TCU (direction); e.g., TCU SW-N
Cumulonimbus	CB (direction)(movement); e.g., CB OVHD MOVG E.
Cumulonimbus mamma	CBMAM (direction)(movement); e.g., CBMAM SW MOVG NE
Altocumulus castellanus	ACCAS (direction); e.g., ACCAS N
Lenticular clouds	ACSL (direction); e.g., ACSL S-NW
Rotor clouds	ROTOR CLDS (direction); e.g., LRG ROTOR CLDS OVR RDGS W-N
Variable Sky Condition	(Present condition)V(variation); e.g., ◑ V ◑ . Use height to distinguish between similar layers; e.g., 18⊕V◍ .
Variable ceiling below 3,000 feet.	CIG (lowest height)V(highest height); e.g., CIG 3V6
Differing Sky Condition at distance from station	Appropriate description; e.g., CIG LWR S OF FLD, LWR CLDS W APRCHG STM, etc.

Figure 2-23. Summary of Sky Condition Entries on MF1-10.

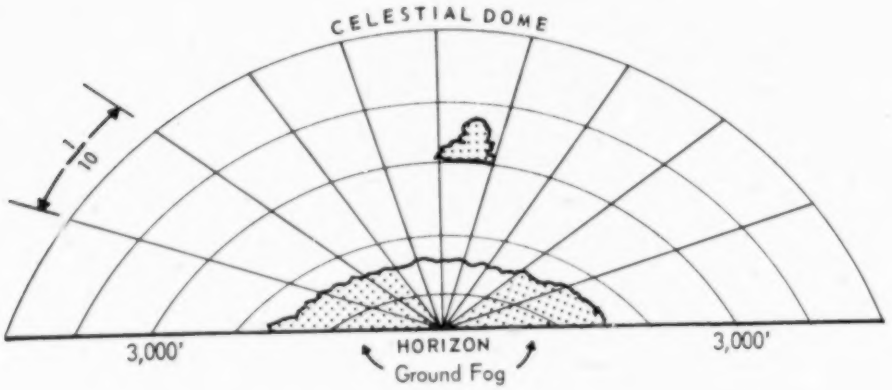
Type	Time (L.S.T.)	Sky and ceiling (Hundreds of feet)	Visibil- (Stat mil)
			Surface
(1)	(2)	(3)	(4)

m- e	Remarks and supplemental coded data	Station pressure (in.)	Dry bulb (°F.)	Wet bulb (°F.)	Total sky cover	Total opaque sky cover	Observer's initials
)	(13)	(17)	(18)	(19)	(21)	(36)	(15)

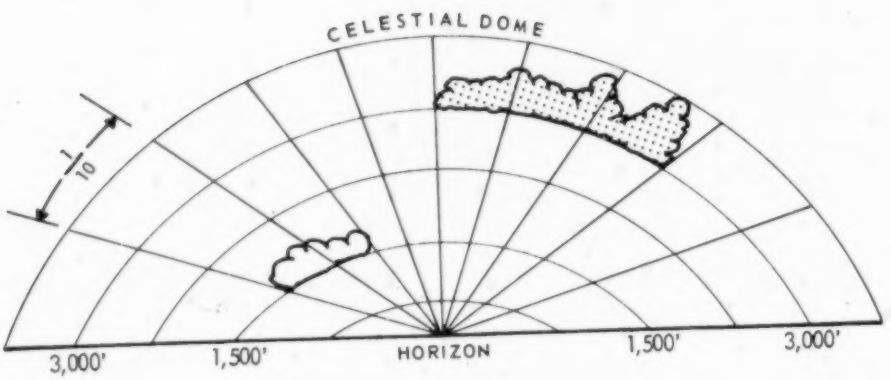
REVIEW QUESTIONS

Remove the sample MF1-10C on the preceding page, and make all appropriate entries for each of the following figures. Use the letter E to indicate the Ceiling if there is one. The figures are constructed in the same manner as figure 2-5. Include Remarks if necessary.

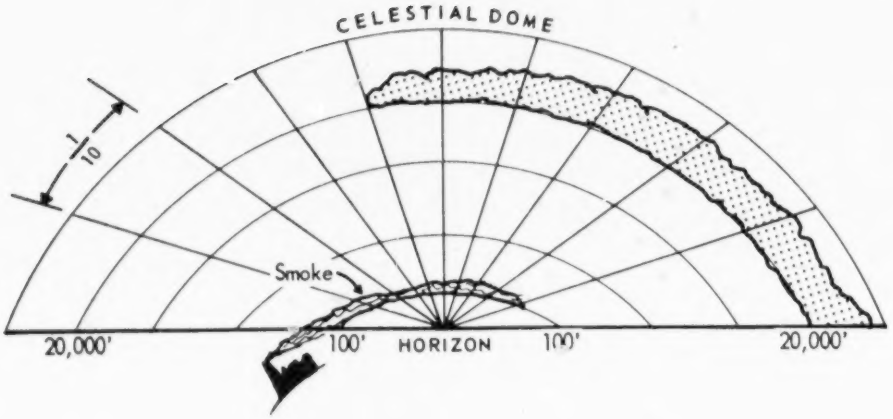
1.

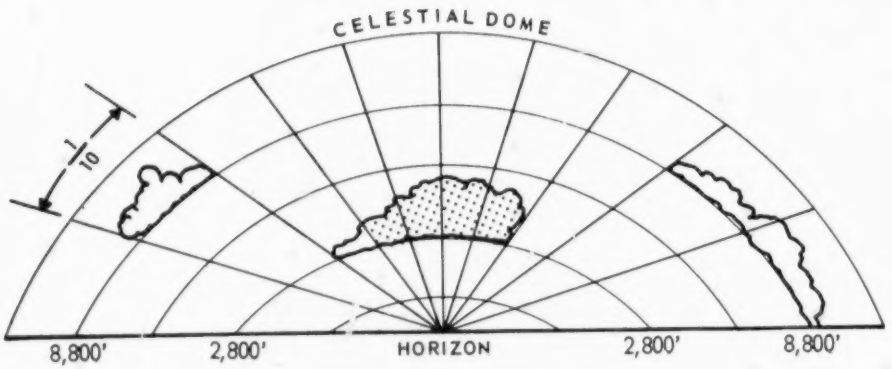


2.

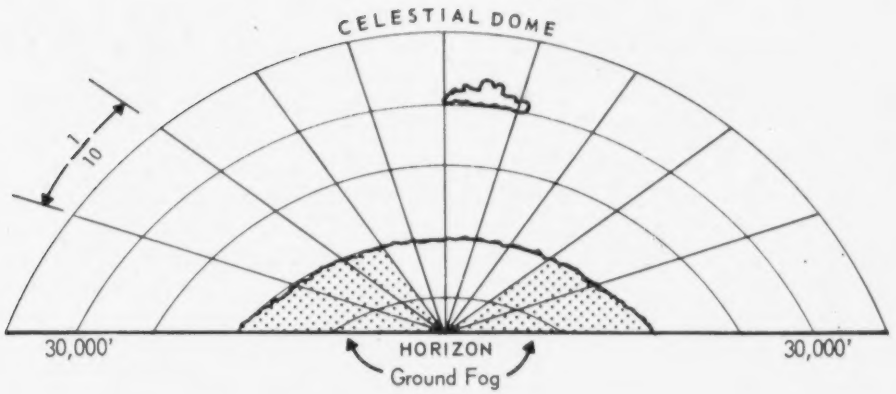


3.

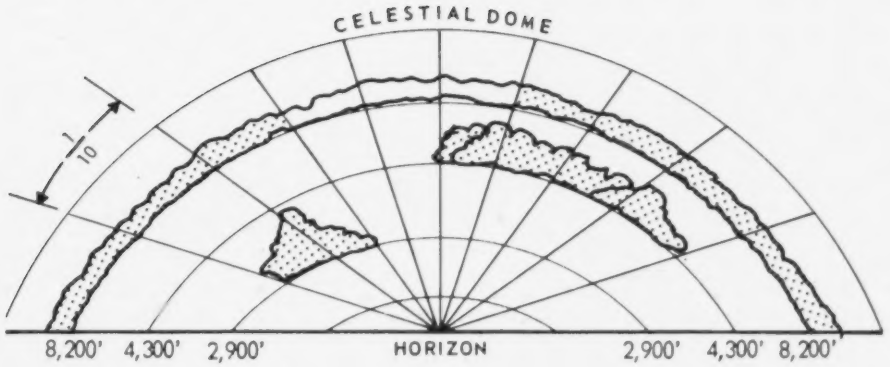

CELESTIAL DOME
1/10
Smoke
20,000'
100'
HORIZON
100'
20,000'


CELESTIAL DOME
1/10
8,800'
2,800'
HORIZON
2,800'
8,800'

5.


CELESTIAL DOME
1/10
30,000'
HORIZON
Ground Fog
30,000'

6.


CELESTIAL DOME
1/10
8,200'
4,300'
2,900'
HORIZON
2,900'
4,300'
8,200'

7. Ceiling heights of 2,500, 2,100, and 2,200 feet are measured during the period of observation. The only layer present is hiding 10/10 sky. The Sky Condition would be reported as_____ and the Remark _____ would be added to the end of the observation.

For each of the following, enter required Remarks as they would appear in column 13 of MF1-10. If no Remarks are required, enter NONE.

8. The sky is overcast, but higher clouds are visible through breaks and thin spots in the overcast. _____

9. A lens shaped cloud is observed SW of the station. _____

10. Towering cumulus clouds are observed in the west from the SW through the N._____

11. A Cumulonimbus cloud is observed to the NE. It is moving to the SW._____

12. Blue sky is visible through breaks in an overcast layer not classified as thin._____

13. Towering cumulus are observed to the SW and a CB is observed to the NW of the station._____

14. Snow is falling from towering cumulus in all quadrants and is obscuring 8/10 sky. _____

15. Snow is falling from a CB that is N of the station. The snow obscurs (hides) less than 1/10 sky. _____

16. The following are the Sky Condition portions of observations taken over a short period of time and are listed in chronological order with the oldest observation at the top. Indicate which observations must be classified as Specials by prefixing the Sky Condition with an S.

a. 250⊕

b. -X250⊕

c. -X3⊕

d. W2X

e. -XM2⊕

f. -XM5⊕30⊕

g. M8⊕30⊕

h. 8-⊕E35⊕

i. 8⊕35⊕

ANSWERS TO REVIEW QUESTIONS

	Col. 3	Col. 13	Col. 21	Col. 36
1.	-XE30Φ	F5	6	6
2.	15-Φ30Φ		5	3
3.	1-ΦE200⊕	K1-Φ	10	6
4.	28Φ90-Φ		8	4
5.	-XE300Φ	F5	6	5
6.	29ΦE43Φ80⊕		10	8
7.	M23V⊕	CIG 21V25	10	10

8. HIR CLDS VSBL
9. ACSL SW
10. TCU SW-N
11. CB NE MOVG SW
12. BINOVC
13. CB NW TCU SW
14. S8 TCU ALQDS
15. CB N
16. S should be prefixed to: c, d, f, and h.

REFERENCES

1. A5-3.5, A3-2.3 thru 2.3.3, 2.13.4, 2.21, and 2.36

2. A5-3.5, A3-2.3 thru 2.3.3, 2.21 and 2.36

3. A5-3.5, A3-2.3 thru 2.3.3, 2.13.4, 2.21, and 2.36

4. A5-3.5, A3-2.3 thru 2.3.3, 2.21, and 2.36

5. A5-3.5, A3-2.3 thru 2.3.3, 2.13.4, 2.21, and 2.36

6. A5-3.5, A3-2.3 thru 2.3.3, 2.21, and 2.36

7. A3-2.3 thru 2.3.3, 2.13.8a, 2.21, and 2.36

8. thru 15. A3-2.13.8a

16. A2-3.7.2

CHAPTER 3

VISIBILITY

Because of its effects on pilots approaching or departing your station, visibility is one of the most important elements in the Aviation Weather Observation. As with the Sky Condition, try to make the visibility report descriptive of actual conditions at your point of observation. If conditions are different over another portion of the field, and you are aware of it, describe the difference using a Remark.

READING ASSIGNMENT

Chapter A6 - Read all; study ¶3.7, 3.8, and figure A6-1; memorize ¶2.2.
Chapter A3 - Read ¶2.4; study ¶2.13.8b and table A3-4.
Chapter A2 - Memorize ¶3.7.2c.

DISCUSSION

The visibility reported in the Aviation Weather Observation immediately after Sky Condition is Prevailing Visibility. This value is reported in statute miles and usually represents the greatest distance you can see in at least 180° around you (see fig. 3-1 through 3-4). However, if the visibility is changing so rapidly that it is difficult to determine the greatest distance in at least 180° around you, use the average of all observed visibilities as the Prevailing Visibility, and report the limits of variability in Remarks.

Determining visibility is not difficult. The reading assignment states that visibility is the greatest distance at which a Visibility Marker can be seen and identified. At times however, you will be called upon to estimate visibilities for which you have no markers. Base the estimate on the sharpness with which the most distant markers can be seen. If the markers can be seen clearly, with little loss of color, and with sharp outlines, it means that the visibility is much greater than the distance to the markers.

If you estimate that the visibility is greater than the distance to the most distant marker visible at the time of the observation, estimate the visibility to be any reportable value up to twice the distance to the last visible marker. If you think that the visibility is still greater than any of the values you are allowed to report, report the highest value allowed and add a plus sign (+) to the value, e.g., 7+, 25+, etc.

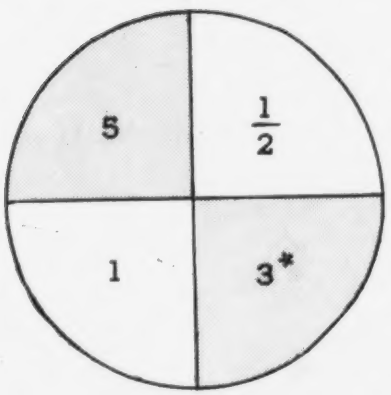
There is one exception to this rule of twice the distance to the most distant visible marker. This exception is where the most distant visible marker is less than 3 1/2 miles from the station. Under this condition, you may report values up to 7 miles regardless of the distance to the most distant visible marker and, if you estimate that the visibility is greater than 7 miles add the plus sign and report 7+.

The user will often assume that the plus sign indicates that the visibility is much greater than the value being reported. Therefore, even though it is "legal" you should be cautious about using the sign if you think that the visibility is only a little more than the maximum allowable value. It is safer for the reported visibility to be a little low than to be misleading.

As mentioned above, the Prevailing Visibility can be defined in two different ways. One of those is the average of all observed values when the visibility was varying rapidly while being observed. When using this method to determine the Prevailing Visibility, and the average of all observed values is less than 3 miles, add a V following the value reported, and in Remarks enter the limits of variability. To make this Remark, enter the contraction VSBY followed by the lowest observed visibility, the letter V, and the highest observed visibility, e.g., VSBY 1/4V1 to indicate that the visibility is varying between 1/4 and 1 mile. Since the reported visibility is the average of all observed values, it is not necessarily the average of the two values given in Remarks, but it usually turns out that way.

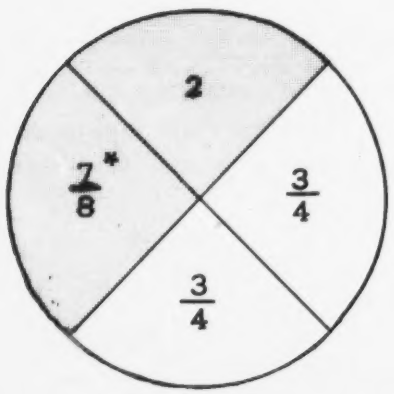
The other case occurs when visibility is persistent, but not equal in all directions. Such conditions are indicated in figures 3-1 through 3-4. The visibility is constant in each of the sectors, but differs from other sectors. In this situation, do not use the average of all the sectors observed to determine the Prevailing Visibility. This is not the type of variation we are talking about when we refer to Variable Visibility. Evaluate this type of situation by taking the sector with the highest uniform visibility and adding to it the sector with the next lower visibility, and the next lower, etc., until together the sectors add up to 180° or more. The Prevailing Visibility is then the visibility in the last sector added to make up the 180°. When the visibility differs in this manner report in Remarks any sector whose visibility is less than 3 miles and different than the reported Prevailing Visibility, or is considered to be operationally significant. To enter this Remark, enter the contraction VSBY followed by the sector (N, NE, E, SE, S, SW, W, NW) and the visibility in that sector, e.g., VSBY E3/4S1/4.

As an aid for determining visibility around the station, all stations are required to have some sort of visibility chart. And to be most useful, this chart should be posted near the point from which you observe visibility. This chart should list or otherwise indicate the location of all Visibility Markers, their distance from the station, and whether they are daytime or nighttime markers. It is also very important that this visibility chart be kept current. An example of the most common type visibility chart is shown in figure 3-5.



5 = 90°
3* = 90°
180°

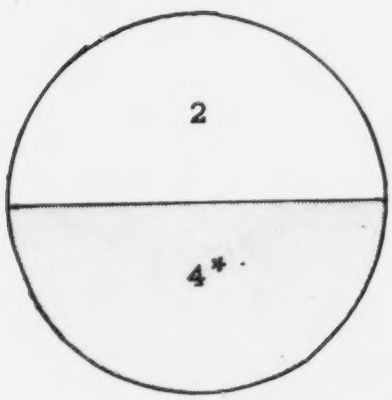
Figure 3-1. Prevailing Visibility 3 miles.



2 = 90°
7/8* = 90°
180°

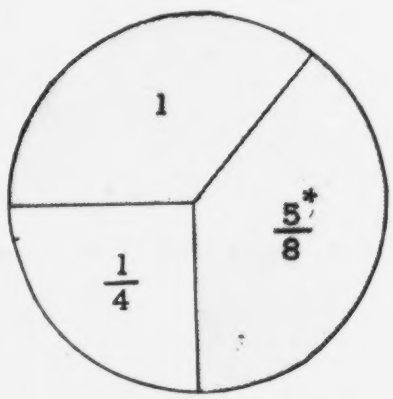
Figure 3-2. Prevailing Visibility 7/8 mile.

Indicates sectors used to determine Prevailing Visibility.
* Indicates Prevailing Visibility.



4* = 180°

Figure 3-3. Prevailing Visibility 4 miles.



1 = 135°
5/8* = 135°
270°

Figure 3-4. Prevailing Visibility 5/8 mile.

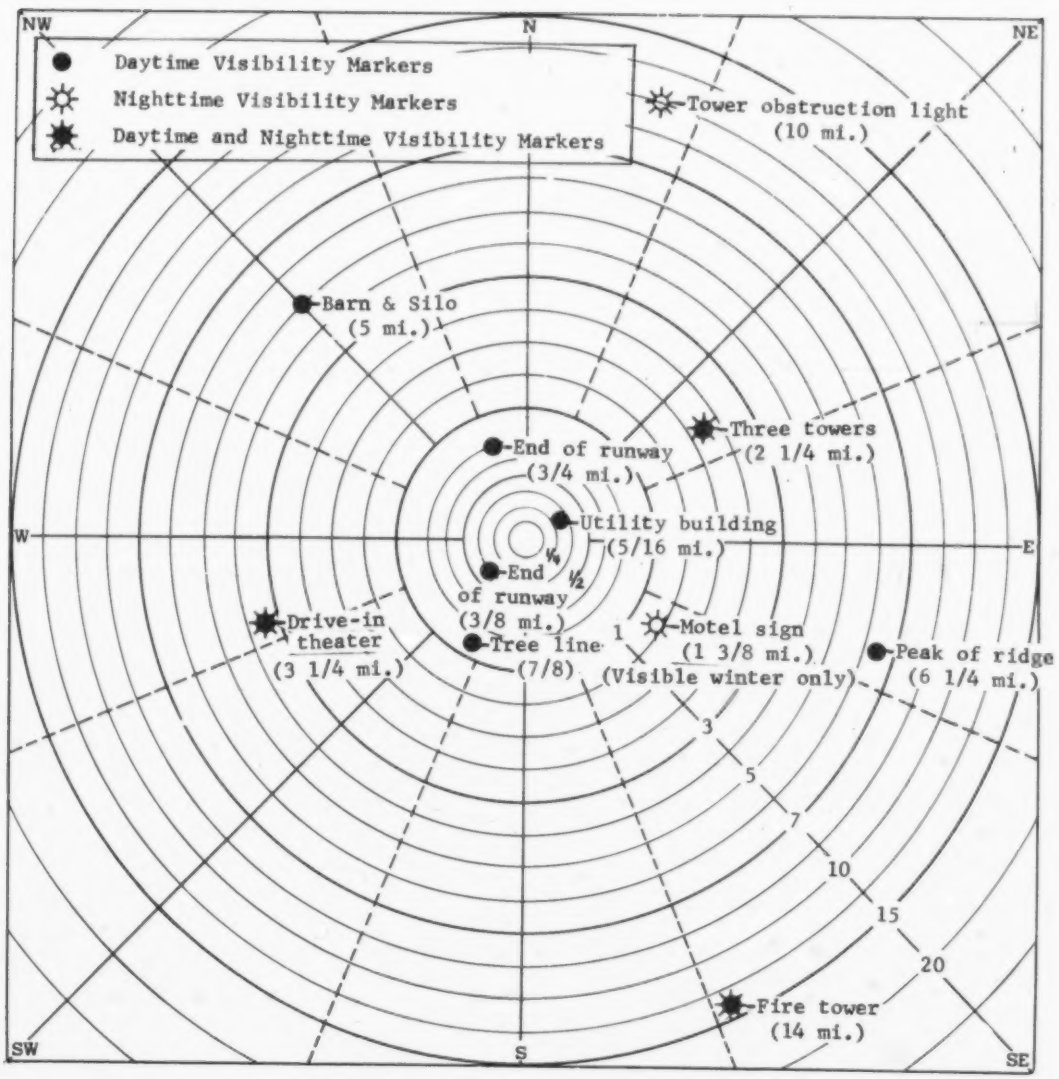
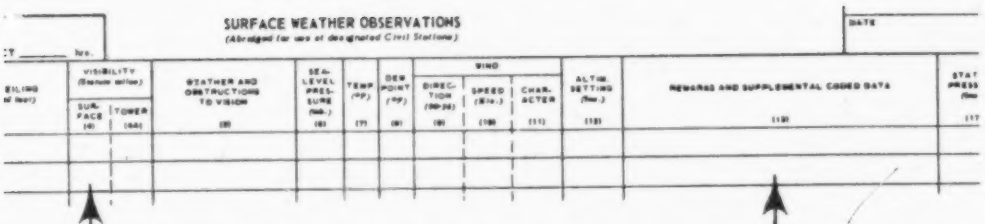


Figure 3-5. Sample Visibility Chart



Remarks

Prevailing Visibility
(statute miles)

SIGNIFICANT REMARKS

If Prevailing Visibility is reported as variable, and is less than 3 miles, enter VSBY followed by the lowest and the highest observed values separated by a V; e.g., VSBY 1/4V5/8.

If a sector visibility differs from Prevailing Visibility and is either less than 3 miles, or is considered operationally significant, enter VSBY followed by the sector, and the sector visibility; e.g., VSBY S1/4NW7.

REPORTABLE VALUES

0	7/8	2 1/4	11
1/16	1	2 1/2	12
1/8	1 1/8	3	13
3/16	1 1/4	4	14
1/4	1 3/8	5	15
5/16	1 1/2	6	20
3/8	1 5/8	7	25
1/2	1 3/4	8	30
5/8	1 7/8	9	35
3/4	2	10	etc.

If Prevailing Visibility is halfway between two reportable values, use the lower value.

If visibility is less than 3 miles, and variable, enter the average of all observed values and add a V.

If visibility is greater than twice the distance to the most distant visible marker, and is greater than 7 miles, encode the visibility as twice the distance to that marker, to the nearest reportable value, or 7, whichever is greater, and add a +.

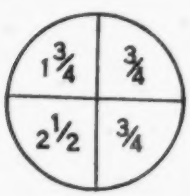
Figure 3-6. Summary of Visibility Entries on MF1-10.

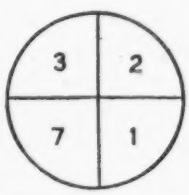
REVIEW QUESTIONS

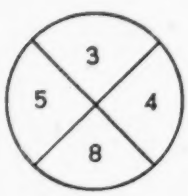
1. Given the following Visibility Markers, cross out the unauthorized reportable visibility values and underline the values that can be used with a plus sign:

Visibility Markers at	Authorized Reportable Visibilities
a. 3, 9, and 20 miles	3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 20, 25, 30, 35, 40, 45, 50 miles
b. 5, 8, and 25 miles	3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 20, 25, 30, 35, 40, 45, 50 miles
c. 2 miles	3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 20, 25, 30, 35, 40, 45, 50 miles

2. The diagrams below represent the visibility in the direction indicated. For each of them, determine the Prevailing Visibility and the required Remarks.







a. _____ b. _____ c. _____

3. At the time of observation the visibility is observed to be varying rapidly between 1 5/8 and 2 1/4 miles with the average 1 15/16. What would the entries be in columns 4 and 13?

4. Visibility is a term that denotes the greatest distance at which:

   a. All objects can be seen and identified,

   b. Selected objects can be seen and identified,

   c. Objects can be detected but not identified,

   d. All objects can be detected but not identified.

5. Prevailing Visibility is defined as:

   a. The minimum visibility that is equalled or exceeded over 1/2 or more of the horizon circle,

   b. The average visibility of all sectors,

   c. The lowest average visibility of all sectors,

   d. The maximum visibility that is equalled or exceeded over 1/2 or more of the horizon circle.

6. When observed visibility is half way between two reportable values, visibility reported is the:

   a. Closest of the two values,

   b. Average of the two values,

   c. Lower of the two values,

   d. Higher of the two values.

7. Visibility is reported in:

   a. Nautical miles and fractions,

   b. Kilometers and fractions,

   c. Statute miles and fractions,

   d. Hundreds of feet.

8. Of the following, the most suitable objects for determining nighttime visibility are:

   a. Unfocused lights of moderate intensity at known distances,

   b. Searchlights,

   c. High intensity runway lights,

   d. Focused lights of moderate intensity at known distances.

9. Report Sector Visibility in Remarks whenever it:

   a. Is non-uniform,

   b. Differs from Prevailing Visibility and is less than 3 miles or is considered to be operationally significant,

   c. Is less than 3 miles,

   d. Is non-uniform and differs from Prevailing Visibility.

10. Prevailing Visibility is reported as variable by adding a V following the reported visibility when it fluctuates by one or more reportable values and is less than:

   a. 7 miles,

   b. 3 miles,

   c. 4 miles,

   d. 6 miles.

11. The following are reported changes in Prevailing Visibility. Put a check mark in front of those that require a Special Observation:

   a. 5 miles to 3 miles,

   b. 3 miles to 2 1/2 miles,

   c. 2 1/2 miles to 2 miles,

   d. 2 miles to 1 mile,

   e. 1 mile to 2 miles,

   f. 2 miles to 2 1/2 miles,

   g. 2 1/2 miles to 3 miles,

   h. 3 miles to 5 miles.

ANSWERS TO REVIEW QUESTIONS

1. a. The following should be crossed out: 8, 45, and 50.
   The following should be underlined: 7, 20*, and 40.

   b. The following should be crossed out: 20.
   The following should be underlined: 10#, 15, and 50.

   c. The following should be crossed out: All above 7.
   The following should be underlined: 7.

   * 20+ would be reported only in cases where the visibility was estimated to be greater than 20 miles, even though the 20-mile marker was not visible due to a restriction in that particular direction.

   # 10+ would be used only in cases where the visibility was estimated to be greater than 10 miles, even though the 8-mile marker was not visible due to a restriction in that particular direction.

   (table A3-4)

2. a. Prevailing Visibility is 1 3/4 miles, Remarks:
   VSBY NE3/4SE3/4SW2 1/2.

   b. Prevailing Visibility is 3 miles, Remarks: VSBY NE2SE1.

   c. Prevailing Visibility is 5 miles, no Remarks.

   (A6-3.8, 3.9, A3-2.13.8b)

3. In column 4, 1 7/8V; and in column 13, VSBY 1 5/8V2 1/4.
   (A6-3.8, A3-2.13.8b)

4. b. (A6-2.1)

5. d. (A6-2.2)

6. c. (table A3-4)

7. c. (A6-3.1)

8. a. (A6-2.7)

9. b. (A6-3.9)

10. b. (table A3-4)

11. A check should be placed in front of b., d., e., and g. (A2-3.7.2c)

CHAPTER 4

ATMOSPHERIC PHENOMENA

READING ASSIGNMENT

Chapter A7 - Read all; study ¶2.1 thru 2.7, 3.1, 3.2.1 thru 3.2.4, 3.3, 3.3.2, and 3.6.
Chapter A3 - Study ¶2.5, 2.13.8c, and table A3-15; memorize table A3-5 and 6.
Chapter A2 - Memorize ¶3.7.2e, f, and g.

DISCUSSION

In the reading assignment, table A3-5 was memorized. This table gives the abbreviations used to report atmospheric phenomena. In addition, the table also indicates a difference between Weather and Obstructions to Vision.

Review the table to see which phenomena are listed under each heading, because even though Weather and Obstructions to Vision may occur together, their reporting procedures are somewhat different. It may help you to remember how they are classified if you remember that Obstructions to Vision come from the ground and Weather comes from clouds.

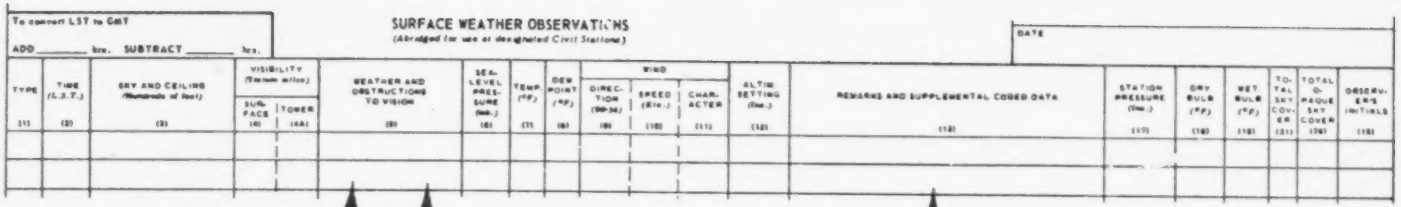
Weather is reported whenever it occurs. If it is occurring at the station and at the time of observation, it is entered in column 5 of MF1-10. If it is occurring at a distance from the station, a description of the phenomenon is entered as a Remark. On the other hand, Obstructions to Vision are entered in column 5 only if occurring at the station, at the time of observation, and the Prevailing Visibility is less than 7 miles. Under all other conditions, reports of Obstructions to Vision must be made as Remarks.

A few other points worth reviewing that were covered in the reading assignment are with regard to the use of Intensity Symbols. We will do this by presenting a list of do's and don'ts.

1. DO base the intensity of Thunderstorms on only the speed of Gusts or size of Hail.

2. DO NOT base the intensity of a Thunderstorm on the appearance of the sky, noise of the storm, intensity of the rain, or amount of hail.

3. DO NOT assign Intensity Symbols to reports of Tornadoes, Funnel Clouds, Waterspouts, Hail (A), Ice Crystals (IC), or Obstructions to Vision (F, H, K, etc.).



Report if occurring at time of observation			
TORNADO		Freezing Drizzle	ZL
WATERSPOUT		Ice Pellets	IP
FUNNEL CLOUD		Ice Pellet Showers	IPW
Severe Thunderstorm	T+	Snow	S
Thunderstorm	T	Snow Showers	SW
Rain	R	Snow Pellets	SP
Rain Showers	RW	Snow Grains	SG
Freezing Rain	ZR	Ice Crystals	IC
Drizzle	L	Hail	A

Precipitation Intensity Symbols

\+ Heavy - Light -- Very Light

Absence of intensity symbol indicates moderate.

No intensity assigned to Ice Crystals or Hail

Report only if entry in col. 4 is less than 7.			
Fog	F	Ice Fog	IF
Ground Fog	GF	Haze	H
Blowing Snow	BS	Smoke	K
Blowing Sand	BN	Dust	D
Blowing Dust	BD	Blowing Spray	BY

TORNADO in progress	TORNADO B___, Direction from station, and Movement; e.g., TORNADO B04 W MOVG
TORNADO in progress	TORNADO B___,Direction, and Movement; e.g., TORNADO B04 W MOVG NE.
TORNADO ends	TORNADO E___,Movement; e.g., TORNADO E55 MOVD NE.
WATERSPOUT or FUNNEL CLOUD	Same as above except use WATERSPOUT FUNNEL CLOUD
Thunderstorm	TB___, Direction, Movement (if known); e.g., TB15 N MOVG S.
Thunderstorm ended	TE___, Movement; e.g., TE40 MOVD SW.
Hail	AB___ HLSTO (size of largest stone in inches); e.g., AB21 HLSTO 5/8.
Hail ends	Same as above except use AE and time of ending.
Lightning	Frequency (OCNL,FQT,CONTUS),LTG, Type (CC,CG,IC,CA), Direction; e.g., OCNL LTGCCICCG N.

Other frequently Used Remarks

OCNL RW(+,-,--)	F DSIPTG or F INCRG
INTMT R(+,-,--)	K DRFTG OVR FLD
WET SNW	SHLW F DEP_____(in feet)
R(+,-,--)OCNLY R(+,-,--)	DRFTG SNW
SNOINCR(increase in inches)	DUST DEVILS
RW(+,-,--) (Direction)	F BANK (Direction)

Figure 4-1. Summary of Weather and Obstruction to Vision Entries on MF1-10.

As you have seen, there are quite a few different types of atmospheric phenomena and to some degree, each is reported differently, especially in Remarks. Until you are familiar with all the phenomena and associated reporting procedures, use figure 4-1 as a guide when making reports.

REVIEW QUESTIONS

1. What are the two differences between Fog and Ground Fog?

2. What is the main difference between Blowing and Drifting Snow?

3. A Severe Thunderstorm is one in which the wind gusts to _____ or more, or the Hail is _____ or larger in diameter.

4. When several types of precipitation are occurring, they are reported in which of the following orders?

   a. Liquid, freezing, frozen,

   b. Frozen, freezing, liquid,

   c. Frozen, liquid, freezing,

   d. Liquid, frozen, freezing.

5. Which symbol or group of symbols indicate the occurrence of a Severe Thunderstorm: T, TRW+, T+RW, or TRWA?

6. Before an Obstruction to Vision is entered in column 5 of MF1-10, it must be occurring both _____ and _____ _____, and in addition must reduce the reported Prevailing Visibility to less than _____ miles.

7. What is the meaning of each of the following symbols when used in column 5?

   a. F

   b. W

   c. R

   d. IC

   e. B

f. S

g. K

h. Z

8. Which symbol is used in column 5 to report each of the following?

a. Blowing Sand

b. Haze

c. Blowing Spray

d. Dust

e. Tornado

f. Hail

g. Thunderstorm

ANSWERS TO REVIEW QUESTIONS

1. Fog hides more than half the sky and/or extends to the base of the clouds. (A7-2.2.11)

2. Drifting snow does not restrict visibility. (A7-2.2.13)

3. 50 knots, 3/4 inch (A7-3.2.3)

4. a. (table A3-5)

5. T+RW (table A3-5)

6. At the station, at the time of observation, 7 (A7-3.6)

7. a. Fog

b. Shower

c. Rain

d. Ice Crystals

e. Blowing

f. Snow

g. Smoke

h. Freezing

(table A3-5)

8. a. BN

b. H

c. BY

d. D

e. TORNADO

f. A

g. T

(table A3-5)

CHAPTER 5

TEMPERATURE AND DEWPOINT

READING ASSIGNMENT

For stations observing both Temperature and Dewpoint:

Chapter A9 - Read all.
Chapter A3 - Study ¶2.7, 2.8, 2.8.1, 2.18, and 2.19.
Chapter A12 - Read ¶6.1 thru 6.9.2.

For stations not observing Dewpoint:

Chapter A9 - Read ¶2.1.1, 2.16, 3.2.1, 3.3.1, and 3.4a.
Chapter A3 - Study ¶2.7.
Chapter A12 - Read ¶6.1, 4.7.1, and 4.7.2.

DISCUSSION

If you will not be observing the Dewpoint at your station, you need only remember to read the thermometer to the nearest whole degree Fahrenheit (°F.) and record the Temperature in column 7 of MF1-10 as read. You may skip the remainder of this discussion and go on to answer review questions 1, 2, and 3.

If you are required to report both Temperature and Dewpoint, you will probably use a psychrometer. This instrument consists of two thermometers filled with either mercury or alcohol and attached to a common backing. The bulb of one thermometer is covered with a muslin wick. This is called the Wet-Bulb Thermometer. The thermometer without the wick is the Dry-Bulb Thermometer. In operation, air is passed over the two thermometers by either a fan, or by spinning the psychrometer. Use the psychrometer as follows:

If the Dry-Bulb Temperature is above 37°F.:

1. Moisten the wick of the Wet-Bulb Thermometer with clean water. When the humidity is very low, use precooled water to avert premature drying of the wick.

2. Ventilate the psychrometer for about 10 seconds. Do this either by turning on the fan, or if a sling or whirling apparatus is used, by facing into the wind and whirling the psychrometer while holding it in front of you at arms length.

3. Read the Wet-Bulb Temperature to the nearest 0.1°F. and make a mental note of the reading.

4. Repeat steps 2. and 3. until two successive readings of the Wet-Bulb Temperature are the same. At this time, read both thermometers and enter the data to the nearest 0.1°F. in columns 18 and 19 of MF1-10.

When it is raining or snowing, dry the Dry-Bulb with a cloth, and shield it from the precipitation long enough for extraneous heat to be dissipated (i.e., for the reading to become stable) and then read it again. Use this reading as the Dry-Bulb Temperature for column 18, rather than the one determined immediately after the Wet-Bulb Temperature was determined. When frost forms on the Dry-Bulb Thermometer, remove the frost with a warm cloth and allow sufficient time for the dissipation of extraneous heat before reading the thermometer.

If the Dry-Bulb Temperature is below 37°F., use the same procedure as above, except:

1. Use water that has been kept at room temperature to moisten the wick.

2. Moisten the wick 15 minutes before using the psychrometer.

3. Check the wick after ventilating the psychrometer if the Wet-Bulb Temperature is below 32°F. If the wick is not frozen, touch it with clean ice or some other cold object to cause freezing.

After you have determined the Dry- and Wet-Bulb Temperatures, compute the Dewpoint with either a psychrometeric calculator or tables. To do this, first determine the Wet-Bulb Depression. This is the difference between the Wet-Bulb and Dry-Bulb Temperatures to the nearest 0.1°F., e.g., a Dry-Bulb Temperature of 2.3°F. and a Wet-Bulb Temperature of -1.3°F. gives a depression of 3.6°F. After getting the depression, determine the Dewpoint from tables or a psychrometric calculator. If you use the calculator, note the instructions printed on it. In any case, use the Wet-Bulb Temperature and the Wet-Bulb Depression to obtain the Dewpoint. After obtaining the depression, ignore the Dry-Bulb Temperature. Do not make the common mistake of using it in calculating the Dewpoint.

Both the tables and psychrometric calculator are designed to give you the Dewpoint with respect to water, which is the value always reported in the Aviation Weather Observation. The Dewpoint can also be determined with respect to ice, but this will concern you only if:

1. The wick of the Wet-Bulb is covered with ice and you can not get a depression (the Dry- and Wet-Bulb readings are the same),

2. The Dry-Bulb Temperature is -35°F. or below, or

3. Ice Fog is present.

When the wick is covered with ice and you are unable to get a depression, consider the Dewpoint with respect to ice to be the same as the Dry-Bulb Temperature and convert it to the Dewpoint with respect to water. However, if this condition exists and Fog (not Ice Fog) is present, assume the Dewpoint with respect to water to be the same as the Dry-Bulb Temperature. Whenever Ice Fog is present, or the Dry-Bulb Temperature is -35°F. or below, there is no need to determine the Wet-Bulb Temperature. Assume that the Dewpoint with respect to ice is the same as the Dry-Bulb Temperature, and convert it to the Dewpoint with respect to water.

The conversion from ice to water can be made easily with the psychrometric calculator. Find the Dewpoint with respect to ice on the T_i scale (A in fig. 5-1) and then read the Dewpoint with respect to water directly opposite it on the DP (or Tw,DP) scale (B in fig. 5-1).

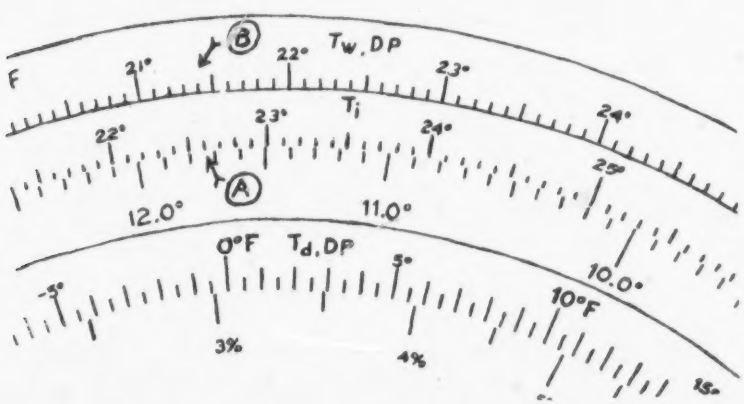


Figure 5-1. Conversion of Dewpoint.

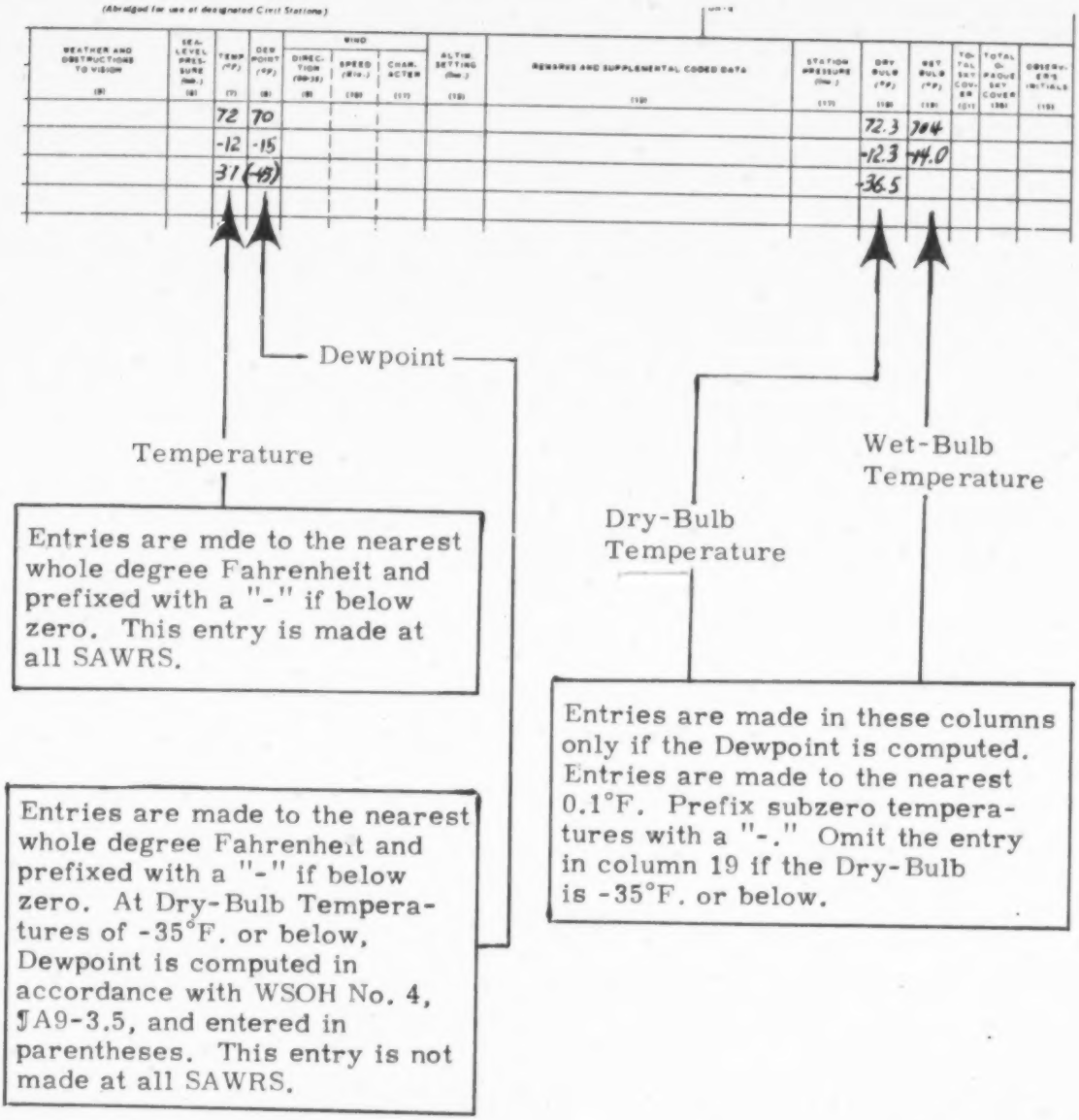

(Abridged for use at designated Civil Stations)
WEATHER AND OBSTRUCTIONS TO VISION
SEA-LEVEL PRESSURE
TEMP (°F)
DEW POINT (°F)
WIND
DIRECTION
SPEED
CHARACTER
ALTIM SETTING
REMARKS AND SUPPLEMENTAL CODED DATA
STATION PRESSURE
DRY BULB (°F)
WET BULB (°F)
TOTAL SKY COVER
TOTAL OPAQUE SKY COVER
OBSERVER'S INITIALS
72 70
-12 -15
31 (-48)
72.3 70.4
-12.3 -14.0
-36.5
Dewpoint
Temperature
Wet-Bulb Temperature
Dry-Bulb Temperature
Entries are mde to the nearest whole degree Fahrenheit and prefixed with a "-" if below zero. This entry is made at all SAWRS.
Entries are made to the nearest whole degree Fahrenheit and prefixed with a "-" if below zero. At Dry-Bulb Temperatures of -35°F. or below, Dewpoint is computed in accordance with WSOH No. 4, ¶A9-3.5, and entered in parentheses. This entry is not made at all SAWRS.
Entries are made in these columns only if the Dewpoint is computed. Entries are made to the nearest 0.1°F. Prefix subzero temperatures with a "-." Omit the entry in column 19 if the Dry-Bulb is -35°F. or below.

Figure 5-2. Entry of temperature data on MF1-10C.

As a check on Dewpoint calculations, remember that the Dewpoint will always be equal to or less than the Dry-Bulb and Wet-Bulb Temperatures. If the Dry- and Wet-Bulb Temperatures are the same, the Dewpoint will also be the same unless the conversion from ice to water is involved.

One final word of caution. Psychrometric calculators are not all the same. Each calculator is designed to be used in only a certain range of pressures. Therefore, if you are selecting a calculator for use at your station, consult table A12-2 in WSOH No. 4. This table shows which calculator to use, depending on the elevation of the station.

Figure 5-2 summarizes the recording procedures for Temperature and Dewpoint on MF1-10C.

REVIEW QUESTIONS

1. How would each of the following Dry-Bulb Temperatures be entered in column 7 of MF1-10?

   a. 36.5

   b. 103.6

   c. -3.5

   d. 0.3

   e. -0.3

   f. 77.6

2. Which temperature scale is used for Aviation Observations?

   a. Fahrenheit

   b. Celsius

   c. Absolute

   d. Kelvin

3. Which temperature is used as the air temperature?

   a. Wet-Bulb

   b. Dry-Bulb

   c. Dewpoint

4. When ventilating a psychrometer, when is the Dry-Bulb Thermometer read? Are there any exceptions to this rule?

5. Under what conditions is the Dewpoint reported with respect to ice?

6. Under what conditions is it unnecessary to determine the Wet-Bulb Temperature in order to get the Dewpoint?

7. Temperatures and Dewpoints are reported to the nearest _____ degree in Aviation Weather Observations.

8. Wet- and Dry-Bulb Thermometers are read to the nearest _____ degree when used to compute Dewpoints.

9. When determining the Wet- and Dry-Bulb Temperatures, which temperature is determined first? Why?

ANSWERS TO REVIEW QUESTIONS

1. a. 37

   b. 104

   c. -4

   d. 0

   e. 0

   f. 78

   (A3-2.7 and A2-1.4)

2. a. (A9-1.1)

3. b. (A9-2.1.1)

4. When the lowest Wet-Bulb Temperature is reached. Yes, when there is a driving rain or snow, or if there is frost on the Dry-Bulb. (A12-6.3.2, 6.1)

5. Never (A9-1.1)

6. When Ice Fog is present or the temperature is -35°F. or below. (A9-3.4, 3.5, 3.5.1)

7. Whole degree. (A3-2.7 and 2.8)

8. 0.1°F. (A3-2.18 and 2.19)

9. Wet-Bulb Temperature. For two reasons; first, the Dry-Bulb is not determined until the lowest Wet-Bulb Temperature is reached, and second, if the Dry-Bulb was read first, the temperature of the Wet-Bulb would be rising while the Dry-Bulb was being read. (A12-6.3.2, 6.1)

CHAPTER 6

WIND

READING ASSIGNMENT

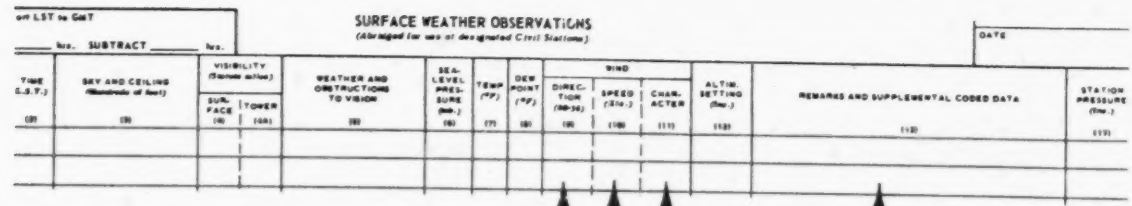
Chapter A10 - Read all; study ¶2.5 and 2.6.
Chapter A3 - Study ¶2.9 thru 2.11, 2.13.6, 2.13.8e, and table A3-7.
Chapter A2 - Memorize A2-3.7.2h

DISCUSSION

Reporting Gusts and Squalls is often a matter of concern to SAWRS observers. This is mainly because these phenomena are normally determined from wind recorders, which are rare at SAWRS. You should not be overly concerned about this. Although there is a requirement to report Gusts and Squalls, the only time it is necessary is if they are observed. That is to say, if within the 10 minutes before the observation you notice the wind gusting, report it. If you do not look at the instrument until observation time, and do not observe any gusting during the 1-minute period you are determining the Speed and Direction, leave column 11 blank.

Remember that Wind Direction is reported in tens of degrees with respect to True North and Speed is reported in whole knots. If there is no wind, report CALM by entering 00 in both columns 9 and 10 of MF1-10; and in the weather report itself, report the wind as 0000.

Paragraph A2-3.7.2 in WSOH No. 4 requires a Special Observation whenever a Wind Shift is observed. Although you are required only to report the Remarks for a Wind Shift, it is recommended that you make the report a complete observation, or at least expand on the Remark WSHFT. This is especially important if aircraft are on approach to the station. The contraction WSHFT by itself does not give much information to a pilot. It would be better to report: WSHFT WND NOW 2920, or something similar. If the observation is only transmitted over the radio, it is perfectly correct to write the Remark out in plain language, e.g., Wind shifted, wind now 290° at 20 knots.



Enter with respect to True North as follows

Observed	Enter	Observed	Enter
355-004	36	175-184	18
005-014	01	185-194	19
015-024	02	195-204	20
025-034	03	205-214	21
035-044	04	215-224	22
045-054	05	225-234	23
055-064	06	235-244	24
065-074	07	245-254	25
075-084	08	255-264	26
085-094	09	265-274	27
095-104	10	275-284	28
105-114	11	285-294	29
115-124	12	295-304	30
125-134	13	305-314	31
135-144	14	315-324	32
145-154	15	325-334	33
155-164	16	335-344	34
165-174	17	345-354	35

If direction, speed, or character is estimated, prefix the direction with an E.

Enter speed of maximum gusts observed in the ten minutes preceding the observation. Prefix this entry with a G for Gust, or Q for Squall. If no gusts or squalls are observed, omit this entry.

If wind direction varies by 30° or more during the observation, and the speed is greater than 6 knots, enter WND followed by the limits of variation, separated by a V; e.g., WND 270V310.

If wind direction changes by 45° or more in a 15 minute period, and remains at new direction, enter WSHFT followed by the time of the change; e.g., WSHFT 1233.

Enter in whole knots using two digits. If speed is 100 knots or more, enter tens and units digits and increase entry in col. 9 by 50.

Figure 6-1. Summary of Wind Entries on MF1-10.

REVIEW QUESTIONS

1. How should each of the following directions be recorded in column 9 of MF1-10 (assuming the speed is less than 100 knots)?

   a. 5°

   b. 273°

   c. 127°

   d. 93°

   e. 2°

   f. 357°

2. Record the following winds in columns 9, 10, and 11 of the sample MF1-10.

Direction (°True)	Speed (Knots)	Character (Knots)
a. 111	15	Gusts to 18
b. Estimated 16	33	Gusts to 56
c. 7	Estimated 11	Not observed
d. 197	3	Not observed
e. 310	115	Squalls to 135

s	Sea level press. (Mbs.) (6)	Temp. (°F) (7)	Dew pt. (°F) (8)	Wind: Direction (9)	Wind: Speed (Kts) (10)	Wind: Character (11)	Altimeter setting (In.) (12)	Remarks and supplemental coded data (13)
			a.					
			b.					
			c.					
			d.					
			e.					

3. A Gust is reported when the wind speed is observed to fluctuate rapidly by_____knots within_____minutes of the observation.

4. A Squall is reported when the wind speed suddenly increases by _____knots and equals or exceeds_____knots within _____minutes of the observation.

ANSWERS TO REVIEW QUESTIONS

1. a. 01

   b. 27

   c. 13

   d. 09

   e. 36

   f. 36

   (table A3-7)

2.

	Col. 9	Col. 10	Col. 11
a.	11	15	G18
b.	E02	33	G56
c.	E01	11	
d.	20	03	
e.	81	15	Q135

   (A3-2.9 thru 2.11)

3. 10, 10 (A10-2.5)

4. 15, 20, 10 (A10-2.6)

CHAPTER 7

PRESSURE

READING ASSIGNMENT

Chapter A8 - Read all, study ¶4.3.
Chapter A3 - Study ¶2.12, 2.12.1, 2.90.5.
Chapter A12 - Study ¶5.2.8.

DISCUSSION

Because of the accuracy requirements for Altimeter Settings, it is important that comparison procedures described in WSOH No. 4 be followed. If you do not make these comparisons, prefix the Altimeter Settings with an E as described in ¶A3-2.12.1. When you do make them, document the comparisons in block 90 of MF1-10 as required by ¶A3-2.90.5 in WSOH No. 4.

Figure 7-1 illustrates the aircraft-type altimeter, the pressure sensor most often used at SAWRS.

Figure 7-1. Aircraft-Type Altimeter.

REVIEW QUESTIONS

1. If two aneroid instruments are used to determine Altimeter Settings, how often should they be compared to each other? How often should the comparisons be entered in block 90?

2. When you read two instruments to determine the Altimeter Setting, and the readings are different, which reading do you use as the Altimeter Setting? Why?

3. When using an aircraft-type altimeter to determine the Altimeter Setting, what height should you set it to before reading it? How often should you reset the indicated height?

4. How should the following Altimeter Settings be recorded on MF1-10?

   a. 28.96

   b. 30.00

   c. 29.99

   d. 30.56

   e. 29.55

ANSWERS TO REVIEW QUESTIONS

1. Each time the Altimeter Setting is determined. The comparison should be entered in block 90 at least once a day. (A8-4.3)

2. The lower reading. The lower reading will cause the altimeter in an aircraft to indicate a lower altitude, thus affording the pilot an extra margin for safety. (A8-4.3)

3. Set it to indicate the actual height of the instrument. This should be done each time the Altimeter Setting is determined. (A8-4.3)

4. a. 896

   b. 000

   c. 999

   d. 056

   e. 955

   (A8-2.12)

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